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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

NOVEMBER 17.

Sheffield Metallurgical Association:—Ordinary meeting. "Ferro-Manganese and other Alloys," Paper by R. A. Hacking, M.Sc.

NOVEMBER 18.

Permanent Way Institution:—Ordinary meeting at Glasgow. "The Practical Application of Electric Welding in the Engineer's Department," Paper by F. E. Harrison.

Institute of British Foundrymen.

NOVEMBER 19.

London Branch:—Ordinary meeting in London. "The Manufacture of Pig-Iron in Relation to the Foundry Industry," Paper by John Crawford.

NOVEMBER 20.

Sheffield and District Branch:—Ordinary meeting. "Further Experiments with Air- and Oil-Hardening Cast Irons," Paper by J. E. Hurst.

NOVEMBER 21.

Wales and Monmouth Branch:—Ordinary meeting at Newport. "The Microscope in Metallurgy," Paper by Prof. A. A. Read, D.Met.

East Midlands Branch:—Ordinary meeting at Loughborough. "High-Duty and High-Test Cast Iron," Paper by H. J. Young.

Lancashire Branch (Junior Section):—Ordinary meeting at Manchester. "Non-Ferrous Founding," Paper by A. Hopwood.

NOVEMBER 24.

Newcastle-upon-Tyne and District Branch:—Ordinary meeting. Discussion on "Coke for Foundry Purposes."

London Branch:—Visit to Staveley Works, Chesterfield.

A Plea for Co-operation.

The result of the recent election has once again emphasised those qualities which are so essentially British, and which are the key to Britain's greatness. Not the least of these is our willingness to face up to unpleasant situations with determination, and the outstanding example of this characteristic was the manner in which all classes of the community voted for the ultimate good of their country, without heeding the impoverishment which each individual must inevitably suffer to achieve the end in view. Such a manifestation as this is not new. It was seen on a much larger scale during the Great War, and in a lesser degree during the general strike of 1926, and, if we can now show more of that courage and understanding in industry, as between employer and employee, we shall render such aid to our country that its future, and more especially the future of those who take part in its industries, will be brighter than it has ever been in our history.

During the latter part of the last century we were a prosperous nation. Our industries were second to none in the world, but, in very many cases, labour was exploited, working conditions were bad, hours were long, and the working classes were, in the main, a suppressed and depressed people. The obvious result was the formation of Trade Unions, which have done a great deal of good in removing most of the evils of the past. Their fierce determination to maintain the standards they had set up, however, has sometimes blinded them to the logical result of some of their demands, as has been seen by everybody during the past two or three months. The pendulum has swung from one extreme to the other, and it is reasonable to hope that it will eventually regain normal, and that capital and labour, which are so vitally necessary to one another, will go forward hand in hand, free from condescension on the one side, and suspicion on the other, to that era of prosperity which will be ours if those characteristics seen in times of crises are given full play in our everyday lives.

There are many factors which militate against fair and harmonious relationship between employers and workpeople. The insecurity of employment of a workman compared with that of, say, a clerk, the granting of paid holidays to the latter and not to the former, the progressive increases in salary given to the one and not to the other, are only a few of the conditions of employment which could be dealt with. On the other hand, there is the question of a fixed rate of wage, not for work done, but for hours of attendance, coupled with the fact that piecework is frowned on by Trade Unions. There is a serious shortage of apprentices in most trades, which is not to be wondered at, when our young men realise that the energetic and skilful man receives exactly the same wage as he who by his indolence only just avoids getting sacked. Labour must tell its followers to take their coats off and do an honest day's work, and Capital must pay a fair wage for that work, raise the status of labour and share with its workers the profits of industry. When a young man starting out in life can enter a trade knowing that his success in life is only limited by his ability, and that his status in life is equal to that of his fellows in other spheres of activity, we shall have gone a long way towards prosperity.

Will the foundry industry lead the way? Its future is a promising one, it possesses brilliant men amongst its employers and skilful and worthy craftsmen are to be found in the ranks of its workers. It only remains for the two sides to meet in the proper spirit, discuss their problems frankly, remembering always that their interests are identical, and the way will be prepared for an industrial revolution which must be for the common good.

Seven Years' Progress.

The Annual Report of the British Cast Iron Research Association considered at the Annual Meeting yesterday provides an opportunity of taking stock of the progress the Association has made, for the Report is the tenth issued since its foundation, and the seventh since it was reorganised in 1924. The Report is of particular interest, and since finance is, and will probably always remain, the chief difficulty of any non-commercial body concerned with technical and scientific work, the financial position is worth considering. The Report shows that during the last financial year the income furnished by the industry has, for the first time, exceeded £5,000, the income actually having trebled during the seven years. This is a record of progress of which the Council and officers of the Association may well be proud. The income has shown a regular rise each year during the period mentioned, and a body which has demonstrated its capacity to raise this sum during the depressed period through which the industry has passed evidently has a good deal of vitality.

XUM

It is well known that the Association is passing through a critical period financially, but it is evident from the above that this is not in any way due to any falling-off in subscriptions as far as the industry is concerned. It is entirely due, in fact, to the fall in the grant which the Association has hitherto received from H.M. Government. It is well known that the research associations were granted Government support for a period of five years, after which it was anticipated that they would be self-supporting. The Cast Iron Research Association was actually able to get this period extended to June of last year, but the last extension was made in 1929 only on condition that in 1931 the industry should double its support to the Association in order to receive the same amount of grant. No one at that time could possibly foresee the deplorable combination which has existed during the past few months, of straightened national finances, and trading conditions which make the period of two or three years ago look almost like a boom. The consequence of the latter is that the industry has not been in a position to furnish all the extra income required, in spite of the goodwill which the Association enjoys, and at the same time Government Departments are being expected to economise in their estimates.

We understand that in view of the vital importance to the industry of maintaining the work of the Association unimpaired, the two leading associations of ironfounders—the National Federation of Ironfounding Employers and the British Ironfounders' Association—made independent representations to the Department of Scientific and Industrial Research, with a view to considering what could be done to meet the difficult situation, and it is to be hoped that some solution will be found. There is an element of hope in the result of the General Election, which cannot fail to have a stabilising effect on industry and stimulate enterprise, quite apart from any changes which may be introduced in connection with imports. It will be recollected that at its own Annual Meeting in June last, the Institute of British Foundrymen unanimously passed a resolution drawing attention to the value to the industry of the work carried out by the Association, and urging all founders to support it as ordinary members.

The Report gives an interesting *résumé* of the progress made on the various investigations carried out by the Association during the year, and these are bound to have a very considerable influence on the technical progress the industry can make in the immediate future.

Speaking with a knowledge of the strides made by our competitors, particularly in France, Germany and America, we have never ceased to advocate the value the Association is, and will be, to the industry. It is not only intrinsically useful, but is of great advertising value, for its work carries the prestige of British founding into many countries, some of which have already seen the wisdom of imitating its organisation and functions.

Book Review.

Secondary Aluminium, by Robert J. Anderson, D.Sc. Published by The Sherwood Press, Inc., Box 2617, Lakewood Branch, Cleveland, Ohio, U.S.A. Price not stated.

Dr. Anderson apparently has an axe to grind, and uses no subtlety in presenting his case. In his preface, he states "Foundrymen . . . found out that the dogma—secondary aluminium is no good, unsuitable and dangerous—so loudly and fervently preached by some producers of primary metal was mere cant." But his axe is not to be sharpened only against the primary-metal producers, but also he wields it with equal force against the remelters, if they exaggerate the worth of their wares. Thus, he pleads for the impartial examination and economic use of each commodity. To tell his story, he has taken 20 chapters, occupying 563 pages; thus, it will be realised, *ab initio*, that a really comprehensive treatise has been prepared. We thought that, after a chat we had with the author some three years ago, he would have adopted the English method of spelling aluminium, as he certainly agreed that it was more authentic in character. Another matter which annoys the British reader is the use of lbs. for extremely large weights. For instance, we are told that in 1929 the U.S.A. consumption of aluminium was 342,557,555 lbs., of which 245,757,555 lbs. was primary and 96,800,000 lbs. secondary. This means that the primary metal consumption was something just over 100,000 tons, and a sufficiently large figure for anybody comfortably to visualise. These small criticisms are not directed at the author but American usages, which no doubt he feels he must follow.

We consider Chapter II—"Kinds and Sources of Scrap"—to be the key to Dr. Anderson's message, as, obviously, clean clippings do not re-enter industry by the same route as grindings or sweepings. In it are detailed the materials entering the scrap market, whilst his next chapter—one which should be studied by every scrap dealer in the land—outlines some commonsense methods of sorting and grading before disposal.

Chapter IV is unique, as it reproduces legal evidence of an alleged attempt by an American aluminium company to corner the scrap market—matter which we have never before encountered in technical works of reference. Moreover, we doubt if it enhances the value of the book from the European standpoint, except, perhaps, to put buyers on their guard when offered contracts embodying the compulsory return of scrap. Chapter VI is written for the technician charged with the evaluation of parcels of scrap, whilst the following ten chapters are for those whose job it is economically to convert light-alloy scrap into ingots suitable for alloying. In them are given, in great detail, the metallurgical principles involved: the available plant, the processes employed, the slags, fluxes and refractories necessary, accessory equipment and allied information. Chapter XVII covers the important question of cost of production of secondary aluminium, and from it one gathers that economic handling is the crucial feature in the competitive market, as material and melting costs will not differ greatly.

The author has utilised the major portion of Chapter XVIII—"Quality and Use of Secondary Aluminium"—by detailing the effect of various impurities, but when, on page 470, he tells us that the use of secondary aluminium, in the form of remelted pig, eliminates mistakes to be associated with faulty weighing when alloying virgin metals, he leaves us unconvinced. A foundry that cannot use a weighing machine when dealing with an expensive metal like aluminium should get out of business. Another argument is that there is no time for checking by analysis when operating with virgin materials and hardeners. Again, we see no difficulty in analysing each consignment as it arrives and withdrawing from assayed stock.

The final chapter covers the economic aspects of the industry, and it is interesting to read of the trend of affairs in America. Unquestionably there has been some bitter feeling over there, which may account for the paucity of aluminium parts in certain makes of American automobiles. However, we feel reasonably assured that such conditions are not likely to be re-enacted in the European market.

The book is excellently indexed, which we suspect is due to the capable handling of Mrs. Anderson; and whilst the illustrations are excellent, many are superfluous, and, to the technician, appeal only as a piece of window-dressing. In conclusion, whilst this book, unlike his previous work, is obviously meant primarily for American consumption, there is much technical data of great material and technical interest to workers in this field in Britain and abroad.

V. C. F.

Random Shots.

You will have observed, you tired, brain-fagged toilers you, dallying with your evening newspapers when duty calls for corrugation of the weary brow over costs schedules, that Lady May Kupp, using as her vehicle the chaste type of an advertiser's announcement, expresses eulogy of a certain brand of toilet preparation which she commends unhesitatingly to the friends who grace her select and elevated plane of Society (a capital case!). Often another than Lady May Kupp—a Roland for an Oliver—will praise a different aid to beauty, but with the same glowing appreciation.

* * *

There are actually people who are pained by the excursions of these gracious personages from the straight and narrow column of Mayfair gossip into the wide open spaces of newspaper publicity. The disgruntled copywriter over his milk and doughnut and "Daily Herald" in Johnson's Court will air his grievance by the hour, but never allow it to die through exposure. There are actually people who delight in the knowledge that the particular brand of soap they use is the brand of soap used by at least one of the petals of the flower of the land. And there are actually people who heed not at all the words, wisdom and signatures of Lady May Kupp and her friends.

* * *

The possibility presents itself of this technique of advertising being practised in the technical Press. There, of course, occasional unsolicited testimonials appear. What if the *solicited* testimonial, with authorship recognised by princely fee, were to make its appearance in the advertisement pages of, say, this Journal? The enterprising purveyor of foundry blackings, for instance, might spring upon you this sort of thing:—

Mr. Blank, ironfounder of international reputation, whose foundry is hourly besieged by visitors from Pekin and Putney, writes of our "Argent" Foundry Blacking:—"A wealth of thirty years' experience of numberless proprietary brands of foundry blackings has convinced me that 'Argent' Foundry Blacking represents the very highest quality of foundry blacking manufactured. It possesses to the full those characteristics required by foundrymen. It will give to castings a skin not outshone even by new patent shoes and smoother than a banana's. Its price is a trifling fraction of its value. I recommend it to foundrymen at every technical association meeting I attend."

Mr. Blank's signature.

IF MR. BLANK USES "ARGENT" BLACKING—WHY NOT YOU?

Delivery service every twenty minutes. Generous sample delivered free of charge on receipt of postcard mentioning this Journal.

* * *

Of course, following in the train of this development would come the formation of an association to protect members from victimisation. Human nature being what it is, we might possibly hear of foundrymen penning the most encomiastic tributes to foundry equipment which they certainly had not used and might never have seen! The association would need to establish an Investigation Committee to consider the sincerity of testimonial authors and speedily formulate a fixed scale of fees. But as this solicited-testimonial advertising technique will, *grace à Dieu*, undoubtely never penetrate into the technical Press, why trouble to enumerate the functions of an association which never will be formed?

Marksman.

The Effect of Heat on the Permeability of Coal-Dust Facing Sands and Core-Sand Mixtures.*

By Walter M. Saunders and Walter M. Saunders, Jun.

In a previous Paper† by the authors, the effect of heat on the permeability of natural moulding sands was discussed. On heating moulding sands containing moisture, the permeability decreases, irrespective of the class of sand or the location from which it comes. At a fairly low temperature—around 200 deg. C.—the permeability is low. Around 300 deg. C. it increases, before falling-off gradually to a very low figure at 1,000 deg. C. This break in the curve has been explained by the liberation of steam from the moist sand and by a small amount of gas from the decomposition of the organic matter in the sand. It is the purpose of this Paper to describe the effect of a facing mixture containing sea coal (the American equivalent of coal dust) on the curves of permeability *versus* temperature of heating. In addition, it was decided to obtain these curves using core sand with binders.

Apparatus and Test Methods.

From the moulding sands used in the previous investigation, two were chosen for use with sea coal. These sands are called coarse and fine, and are described as follow:—

Sand.	Name.	Grain fineness.	Clay substance.	Loss on ignition.
Coarse..	Millville gravel..	45	15.56	2.41
Fine ..	Albany	98	10.80	1.60

The sea coal had the following analysis: Moisture, 0.82; volatile matter, 32.37; ash, 9.78, and fixed-carbon, 57.03 per cent. The grain fineness was 148. The distribution on the sieves was as shown in Table I.

TABLE I.—*Sieve Distribution of Coal Tested.*

Sieve.	Per cent.
20	1.24
30	10.22
40	7.34
50	11.06
70	8.86
100	6.98
140	7.84
200	7.12
270	5.88
Through 270	33.46
	100.00

Using the modified type of A.F.A. standard ramming apparatus, cores of sand, containing 6, 8, 10, 12 and 14 per cent. by weight of sea coal, were made. In all cases the moisture content of these cores of moulding sand was held at 6 per cent.

It is realised that a fine sand like the Albany sand is not commonly used in mixtures of sea coal for facing. However, extreme cases were desired in these experiments, and for this reason it was included.

In addition, cores were made of core-sand mixtures actually used in the foundry. Out of several sands tested, three were selected. The proportions of a commercial oil-binder and core sand were 1 to 60, 1 to 55, and 1 to 45. These mixtures were called C-4, C-5 and C-6 respectively. The cores were baked in the tube at 200 deg. C. for 15 min. before use in the permeability tests. The properties of the core sands used were as follow:—

	Grain fineness.	Loss on ignition.
C-4	63	2.26
C-5	122	2.13
C-6	180	2.36

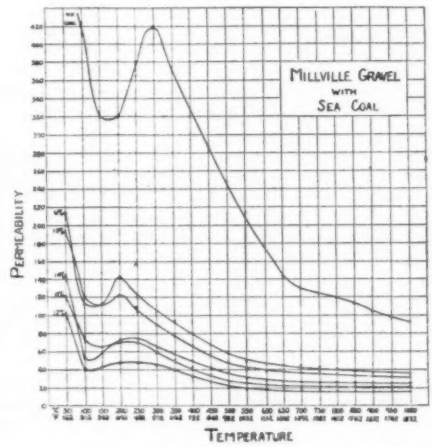

FIG. 1.

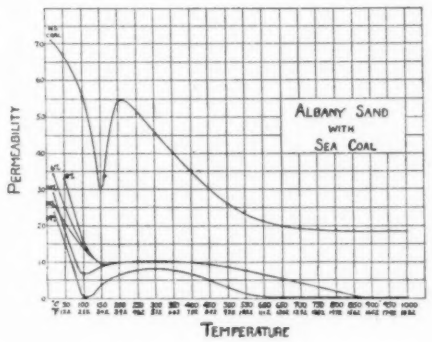

FIG. 2.

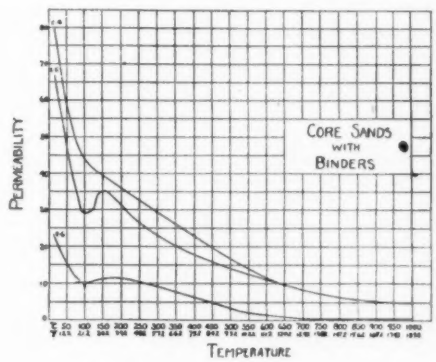

FIG. 3.

During the heating of the test cores, permeability readings were obtained at each 50 deg. C. interval up to 1,000 deg. C. In like manner, on cooling from 1,000 deg. C., the permeability was determined. To heat gradually to 1,000 deg. C. required about 3 hrs., while the operation of cooling to room temperature took about 4 hrs. Determinations were made of the loss on ignition of the dry mixtures of moulding sand and sea coal before the test cores were rammed. At the end of each run the volatile combustible matter left in the sand was determined, using the same method as in coal.

Results.

The permeability readings as ordinates, and the temperature as abscissæ for heating the cores, are shown in Figs. 1, 2 and 3. No plot is made of the results obtained on cooling from 1,000 deg. C. to room temperature. The heating curves for both moulding sands without sea coal are shown as a matter of comparison. The results of the determinations of loss on ignition of the dried moulding sands containing sea coal are summarised in Table II. Volatile combustible matter left in the moulding sands on heating to 1,000 deg. C. and cooling to room temperature is shown in Table III.

TABLE II.—*Loss on Ignition on Dried Moulding Sands.*

	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Sea coal ..	6.00	8.00	10.00	12.00	14.00
Coarse ..	9.06	11.53	12.24	14.05	15.80
Fine	7.13	8.88	10.48	12.25	13.81

TABLE III.—*Volatile Combustible Left in Moulding Sands Heated to 1,000 deg. C.*

	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Sea coal ..	6.00	8.00	10.00	12.00	14.00
Coarse ..	0.79	0.83	0.92	0.87	0.90
Fine	0.67	0.77	0.65	0.55	0.74

Discussion of Results.

As expected, the curves of permeability *versus* temperature are similar to those previously reported. The break in the curve, around 200 deg. C., is at a slightly lower temperature for moulding sands containing sea coal than for natural moulding sands. It is believed that this is due to the gas from the sea coal starting to come off earlier.

Under the conditions of the test, the volatile matter from the coal was distilled off practically in the absence of air. This volatile matter caused considerable back pressure, and in some cases blew the liquid out of the manometer of the permeability apparatus. The sea coal exerted a striking effect on the permeability of the sand at room temperature. Even after the volatile matter had been removed by heating, the effect was still noted. The test-cores of core-sand mixtures also follow the same general curves as the above. No break in the curve was expected at 200 to 300 deg. C. The cores were supposedly dry, since they had been heated to 200 deg. C. for 15 min. before use. That there is a break in the curve suggests that some moisture was present. It is believed that this moisture was taken up by the core-sand mixtures, after they were dried, and then cooled to room temperature.

The volatile matter left in the sand after heating to 1,000 deg. C. shows that practically all of the volatile gases have been distilled out of the coal. The loss on ignition of the heated cores was not determined, because it would include the fixed carbon also. For like reason, the volatile matter of the sand and sea-coal mixtures before heating was not determined, as the water chemically combined would be included. It is believed that the results of these tests confirm the theory which has been advanced by many regarding the action of sea coal in facing sands. At different times, various statements have been made that gas from sea coal acted as a cushion between the mould and the molten iron, thus preventing the iron from sticking to the sand. Dr. Moldenke described, in an address before a group of foundrymen, experiments made with facing sands containing sea coal, using a mould with a mica window. The evolution of gas from the coal, and the setting of iron in the mould, was observed in this way.

From the permeability readings obtained on

(*Concluded on page* 307.)

* This Paper was presented and discussed at the 1931 Convention of the American Foundrymen's Association.

† Saunders, W. M., and Saunders, W. M., Jun., "Effect of Heat on the Permeability of Natural Moulding Sands," Transactions, A.F.A. (1930), Vol. 38, p. 259.

The Lighting of Foundries.

By "Kilowatt."

So great has been the development in the provision of artificial illumination in factories and workshops, and so intense the propaganda on the value of lighting, that to-day it is generally recognised that good lighting has become as important an aid to production as good machinery. The result has been that managements of industrial concerns have been called upon to give serious thought and attention to this subject, and engineers have been asked to prepare specifications for the improvement of existing installations or the lay-out of an entirely new system of lighting.

The situation thus created demands a knowledge of the various systems of industrial lighting in order to apply them correctly to the existing local conditions, for no one system can be said to be the best until each case has been considered in the light of its own special circumstances. These notes have, therefore, been written to render the knowledge collected on this subject readily available to those responsible for the lighting of foundries.

Fundamentals of Good Lighting.

Before any attempt is made to deal with the details applying to foundry lighting, one must first consider a few general points of fundamental importance. In any lighting scheme, which should cover both indoor and outdoor lighting, it is essential that light should be directed where it is wanted. Even this fundamental is often neglected, and one sees again and again a light which will shine right in an operator's eye instead of on the work. Equally in yards and roads the atmosphere surrounding lighting units may be most brilliant, while the road is very poorly illuminated. Therefore, "light where it is wanted" must be the first step towards successful lighting. The second step follows closely in the same path and is the provision of "plenty of light where it is wanted." Lists showing foot-candles required by statute or recommended in various countries for industrial processes are published in certain handbooks. It is worth studying these and then ascertaining whether the standard is reached in one's own foundry. One other fundamental in good lighting is the elimination of glare and inconvenient shadows.

It must not be assumed, however, that compliance with these fundamental principles is all that is needed, because the exact lighting conditions most favourable to rapid and accurate work must be determined. Each foundry presents problems of its own, atmospheric conditions must be studied to see whether special dust- or moisture-proof fittings are called for, and the lay-out of the foundry itself will to some extent govern the position of some of the lighting units.

Systems of Lighting.

In general, two alternative methods present themselves: *general lighting*, when the foundry as a whole is flooded with light from above, and *local lighting*, when separate lighting units are assigned to each machine. General lighting has usually the advantage of lower cost of installation. Furthermore, it enables lamps of relatively high candle-power, which are more efficient and robust, to be used. Manufacturers of industrial electric lighting reflectors have given much time and care in the design of a scientific unit, with the result that there are now available numerous types of reflectors designed to meet every possible condition. Each fitting has its own particular use, and without doubt their application raises the efficiency of the lighting installation to a marked degree.

In foundries or assembly areas where large units are handled by cranes, the ceiling is usually 30 or 50 ft. high. These areas are best lighted by reflectors designed for high mounting heights. The ceiling of such a building usually consists of structural cross-beams supporting the roof. In a building of this design high-mounting reflectors should be symmetrically arranged in one or more rows, the length of the area, the lighting units being mounted on each beam or on the first beam and between the second and third, etc., the length of the building. The arrangement depends upon the width and height of the shop and upon the number of trusses, as well as upon the amount of light needed for the particular manufacturing operation carried on below.

Where the walls of the building to be lighted are dark, or where a high value of vertical illumination is desired, elliptical or symmetrical angle reflectors may be mounted on the side walls under the crane rails about 20 to 25 ft. above the floor, and equipped with lamps with enamelled bowls of the proper size. This mounting height is necessary in order to keep the light source above the line of vision of the workmen. Also, care should be exercised to see that the reflectors are fitted with the proper lamps, because a reflector equipped with a lamp that is too small causes spotty illumination, and a reflector equipped with too large a lamp permits the filament of the lamp to come below the proper position in the reflector, causing glare, which is equally detrimental.

From the moulder's point of view, more light is required at the working plane when moulds are being prepared. This can be obtained from wall plugs and wandering leads. Each unit, however, should be fitted with a movable reflector so that the moulder can move it round in such a manner that the light is projected upon the correct portion of the mould. In this way the work is illuminated with light completely devoid of glare, and the operations can be performed in comfort.

When dealing with the reflection factors of various-coloured walls, it must be borne in mind that practically the whole of the light which strikes a black surface is absorbed. Remembering this, it may be considered that the type of unit described for general lighting would not allow the travelling-crane driver in a foundry easily to see the work on the floor, and that excessive contrasts in illumination would exist between the upper and lower part of the foundry. This is not so. All objects are seen by the light which is reflected from them, and, although casting sand is black, it is composed of myriads of small mirrors, which offer a reflecting surface to the light rays. In this way the driver can clearly see even the details of the moulds, and the upper portion above the traveller is illuminated with well-diffused light of rather low intensity.

Regarding the portions of the foundry where other operations are carried out, a system of general lighting will be sufficient here. The type of unit to install is the dispersive dome reflector, the height and spacing of these units depending upon the height and width of the interiors.

Correct Lighting Intensity.

The requisite intensity for any particular industry will naturally depend upon the nature of the work. For instance, less light is necessary in a shop engaged upon rough work than in a shop devoted to fine and exacting work, and lighting engineers, as a result of experience, are able to specify with accuracy the lighting intensities most suitable for any particular class of work. As an indication of the intensities recommended at the present time, an illumination of 6 to 10 foot-candles is desirable for rough machine work, while for fine work intensities of 10 to 20 foot-candles are necessary. Some idea of the moderation of such recommendations can be appreciated when the intensities common in daylight are considered. Outdoor illumination on a sunny day, for instance, ranges from 8,000 foot-candles to 500 foot-candles in the shade, while daylight intensities in the average workshop interior may range from 20 to 250 foot-candles.

There is some confusion as to the relation between the size of the lamp and the amount of light reaching the work. The size or candle-power of the lamp only gives an indication of the amount of light the lamp will emit, and does not provide a safe index of the illumination obtained where it is required. The light emitted by a lamp has sometimes been called "raw light," since it must be directed and controlled by a reflector before effective illumination on the working plane is obtained.

The unit of illumination is called the "foot-candle," and is used to specify the actual amount of light required for the class of work in hand, and if one aims at an all-round figure of 10 foot-candles for the foundry, a good standard of illumination will have been attained.

Measuring Light.

Illumination in foot-candles can be as readily measured as the temperature of a room, and there are now available many instruments known as portable photometers which will give a direct measure of the amount of light reaching any working surface. The use of such instruments provides the only satisfactory way of telling whether the illumination available for a particular class of work is up to the recommended value, since the eye, by itself, will not give a reliable measure of light intensity.

Many otherwise satisfactory lighting installations, although providing sufficient light at certain points, suffer from the defect of allowing the illumination in between the units to fall far below recommended values, while many industrial operations require that the illumination provided shall be uniform throughout the whole working area. This defect is largely due to the lighting units being too far apart. In many establishments, insufficient attention is given to the question of maintenance, and it is not realised that *no less than 30 to 40 per cent. of the light emitted from the lamp may be lost due to the accumulation of dust and dirt*, either on the lamp or on the reflecting equipment. Here, again, an instrument measuring illumination can be employed to check up the lighting system to see that it is being properly maintained.

Wiring Systems.

The question of wiring is equally important. In order that electrical energy may be conveyed to the lighting points a system of current-carrying conductors has to be provided. These conductors are usually of the V.I.R. class or C.T.S. In the V.I.R. (vulcanised india rubber) system the wires contained within the conductor are composed of soft-tinned copper, covered with several layers of rubber-coated tape and an outside braiding treated with a waterproofing compound. Where it is desirable to install a high-grade conductor which will maintain its dielectric strength throughout a long life, one of the Association (Cable Makers' Association) grades will naturally be selected, and for working pressure up to 250 volts a 600-megohm grade conductor will give good results. If, however, low initial cost is a governing factor, non-association conductors may be used.

With regard to the C.T.S. (cab-tyre sheathed) conductors, this class consists of insulated high-conductivity tinned copper wires sheathed with a layer of hard rubber of specially tough and durable quality. This sheathing is waterproof and acid and oil resisting, and it forms an excellent and non-metallic armouring. In most lighting installations in foundries it is advisable to enclose the conductors in some way which will

(*Concluded on page* 310.)

British Cast Iron Research Association.

TENTH ANNUAL REPORT FOR YEAR 1930-31.

The year under review completes ten years' activity on the part of the Association since its inception and seven since its reorganisation in 1924. The income has again shown an increase over the previous year, and the annual subscription income from the industry has very nearly reached £5,100. Total receipts, in fact, from the industry have exceeded £5,100, as in some cases additional payments have been made in respect of the use of the new cupola. The programme of research and development has been steadily pursued and in many respects the year has been the most important in the history of the Association.

At the end of the year the arrangements with H.M. Government, by virtue of which the Association obtained £ for £ grant on industrial subscriptions, came to an end and a new scheme, referred to in the last Annual Report, came into existence as from July 1, 1931. By this scheme, grant is only to be paid on subscriptions over £5,000 per annum, at the rate of £ for £. The unfortunate effect of the coincidence of this change with the profound financial crisis through which the nation is passing is referred to more fully below.

Council.

In view of the changes pending during the year in grant terms, the Council appointed on July 2, 1930, a Ways and Means Committee, consisting of all members of Council representing subscribing members, to consider the situation. This Committee held several meetings and its recommendations were unanimously adopted by the Council. They are referred to more fully below.

Over eighty member-firms, nominating more than 100 persons, are now represented on the Council and Committees. The Association is greatly indebted to those who give so generously of their time and experience in this way.

In view of the possibility of extending membership among eligible manufacturers overseas the Council appointed three Honorary Corresponding Members: Mr. O. W. Ellis, Director of Metallurgical Research to the Ontario Research Foundation, has kindly consented to act for Canada; Mr. J. C. Mahindra, Chief Technical Engineer to Martin & Company, Limited, Calcutta, for India; and Mr. W. T. Main, of T. Main & Sons Pty., Melbourne, for Australia. The thanks of the Council are due to these gentlemen for their willingness to give information relating to the work of the Association to prospective members in those countries.

RESEARCH COMMITTEE.

The Research Committee is responsible to the Council for the formulation and supervision of the research and development programme and operates through a number of sub-committees. During the year adjustments have been made in the work of these sub-committees, and their number has been increased so that each main section of the industry is now represented by a sub-committee according to the type of product manufactured. The complete list is as follows:—Grey Iron Sub-Committee; Nickel and Alloy Cast Iron Sub-Committee; Malleable Cast Iron Sub-Committee; Pig-Iron Sub-Committee; Light Castings Sub-Committee, and White and Chilled Iron Sub-Committee. In addition, matters of common interest to all sections of the trade are dealt with by three other sub-committees as follows:—Sands and Refractories Sub-Committee; Tests and Specifications Sub-Committee, and Cupola Sub-Committee. Panels are formed from these sub-committees as and when required for special purposes.

During the year Mr. W. H. Whitehouse, A.M.Inst.C.E., M.I.Mech.E., was elected Chairman of the Research Committee. The progress made on research and development is briefly summarised below.

Moulding Sands and Refractories.

The investigation being conducted by Dr. J. G. A. Skerl at the University of Sheffield under the supervision of Mr. W. J. Rees, B.Sc., on moulding sands and refractories has been steadily pursued. In particular the work on the application to practical foundry conditions of the principles discovered during the research has taken up much of the time of the investigator, and during the year he has visited fifty-three foundries in connection with moulding sand problems, and reports have been issued in connection therewith, usually after laboratory examination of samples. Furthermore, problems relating to sands from twenty-seven foundries have been dealt with by correspondence. With a view to the formulation of specifications for sand for particular classes of work, visits to groups of foundries which had been made previously in the Midlands and in Lancashire were continued in Scotland and East Anglia, and samples of the typical facing sands used in those areas have been examined to this end. The use of the apparatus devised by the Association for the daily control of strength and permeability of moulding sand is steadily extending. Research Report No. 73, which dealt in full with the series of tests used in the research on moulding sands, is out of print and a further issue is contemplated. Work is progressing on the development of rapid means of determining moisture in sands and on test methods for determining the permeability of dry-sand cores.

The attention given to development naturally limits the rate at which research work can be advanced until such time as further scientific assistance can be provided, but work has been done on properties of core binders used in conjunction with typical core sands and on the properties of linseed oil in relation to its use for oil-bonded cores either alone or in conjunction with other materials. A number of cupola refractories of the ganister and monolithic types have also been examined.

Heat-Resisting Cast Iron.

The investigation of the heat-resisting and other properties of the high silicon cast iron developed by the Association and known under the trade name "Silal" has been continued, particularly with respect to properties at high temperatures. These irons are rather more brittle than good engineering irons at ordinary temperatures, but cantilever tests carried out at high temperatures (800 to 1,000 deg. C.) have shown that the high silicon irons are much more rigid under load at operating temperatures than mild steels and good engineering irons. Arrangements have been made for creep tests by the Committee on the behaviour of materials at high temperatures of the Metallurgy Research Board. In view, however, of the importance of a measure of toughness at ordinary temperatures often required, attempts have been made to produce an alloy which has mechanical strength at low temperatures comparable with the good engineering irons. An alloy "Silal" has been developed for this purpose which has been named "Nicrosilal," the alloying elements being principally nickel and chromium. Tests have shown that this is even better under heat with respect to resistance to scaling and growth than "Silal" itself. One independent test has shown that an alloy "Silal" actually melted without showing signs of scaling.

A number of members have experimented with the commercial development of these alloys, and many difficulties have been overcome. It has been found essential to ensure in "Silal" the proper structure as well as the proper composition, the structure consisting of fine graphite in a matrix of ferrite. Particular care has to be exercised in selecting the mixture to ensure the correct structure when obtained from the cupola furnace. The Association therefore maintains very close co-operation with members making "Silal" iron.

The properties of these alloys have been confirmed independently by investigators in Germany, while an important group of works during the year carried out systematic tests on commercially made material with a view to its industrial use on a large scale. After heating a series of samples of ordinary iron and "Silal" for twenty-four hours at temperatures of 500 to 1,000 deg. C. in an open electric furnace in contact with air, the gain in weight of the samples was measured and the relative increase in weight of the two irons was compared. "Silal" was shown to be very much superior to ordinary cast iron in resistance to oxidation, and from the point of view of scaling alone it was concluded that the iron may be expected to have reasonable life at temperatures up to 900 deg. C. It was also reported that the later stages of growth, which are the result of oxidation along graphite flakes, take place very much more readily with ordinary iron. In a series of growth tests samples were heated to a temperature of 1,000 deg. C. and cooled in air six times. It was found that ordinary iron had grown over twenty times the amount shown by the "Silal." Bars were also heated in a gas furnace for periods of twenty-four hours at temperatures ranging from 500 to 1,000 deg. C. and were subsequently tested after cooling. It was found, as is indicated above, that the "Silal" was definitely lower in mechanical strength at ordinary temperatures when compared with ordinary grey iron. Exposure to temperatures up to 800 deg. C. did not produce much alteration in strength in either iron, but after heating to 900 deg. C. and beyond, the strength of the ordinary iron deteriorated very rapidly and very considerably. The strength of the "Silal," however, increased steadily, and after heating to 1,000 deg. C. was higher than either the ordinary iron or the "Silal" tested without this treatment. The report concludes that there is no doubt that "Silal" iron is a very great advance in resistance to oxidation, and provided that the castings are of a convenient size and that the conditions of service do not involve any mechanical stress or shock, "Silal" iron can be recommended for use at temperatures up to 900 deg. C. These results amply confirm tests in the B.C.I.R.A. laboratory.

Ingot Mould Iron.

The first report on the investigation of the thermal properties of ingot mould iron, being carried out in connection with the Heterogeneity Committee of the Iron and Steel Institute and the Iron and Steel Industrial Research Council, is nearly complete. Iron from three ingots moulds made by different makers have been tested, both before and after use. The thermal conductivity tests have been made by Dr. J. W. Donaldson, of Greenock, and in the Association's laboratories complete chemical and microscopic analyses, mechanical tests, specific gravity, electrical resistivity, and thermal expansion tests have been made.

Cupola Melting Practice.

The industrial development of the soft-blast cupola of the type originally evolved by the Association has been continued during the year, but much greater progress has taken place in the industrial development of the new balanced-blast cupola. The broad principle of this was outlined in the last Report, and the results obtained on the original installation were

described. During the year five cupolas have been made and installed in England, varying in size from 21 in. to 54 in., with outputs from 2.5 to 12 tons per hr. It was considered necessary to proceed with caution as it was important to make sure that the principle would apply equally to small as to large cupolas and to cupolas using the wide variety of mixtures employed under the widely differing conditions of the trade. This has now been proved. Except in special conditions the normal coke consumption for all sizes is about 14:1, representing in general a saving of 25 to 40 per cent. of the usual coke consumption. The metal temperatures yielded are high, being 1,400 to 1,450 deg. C. While definite data are not yet available with respect to melting losses, losses of silicon and manganese through oxidation are reduced and the non-oxidising character is further indicated by the fact that total carbon remains practically the same and that the recovery of bed coke is usually 50 to 60 per cent. This high figure makes the bed coke consumption of the cupola no more than that of an ordinary cupola with a single row of tuyeres, in spite of the higher coke bed required. The output for a given diameter is also higher than that of an ordinary soft-blast cupola. Arrangements are now in progress for any trade member of the Association making cupola equipment who wishes to quote for and manufacture this cupola to do so, but the cupola can only be supplied to ordinary full members of the Association.

Some of the cupolas installed are new, others are conversions of existing plant. In either case, in view of the cost of its development and the provision of subsequent service, the Council charges a fee according to the size of the cupola. This is fixed at £7 per ton of hourly output, this being taken as 0.75 ton per hr. per square foot of bore area at the tuyeres. A 35-in. cupola having a calculated hourly output of five tons would thus carry a fee of £35. Development is continually in progress with a view to cheapening the design and the consultant is present when every balanced-blast cupola is run in. This has proved of great value as a means of instructing cupola men in the best methods of handling the furnace. The cupola has already shown its value in connection with the production of "Silal" cast iron, the structure and properties of which have been shown to be particularly good from this cupola.

Malleable Cast Iron.

The investigation referred to in the last Report as contemplated has been completed and the results presented by the Senior Metallurgist as the British Exchange Paper to the Milan International Foundry Congress on behalf of the Institute of British Foundrymen. The investigation covered the determination of tensile and bend tests on both blackheart and whiteheart malleable iron in test-bars of varying size. The round bar was found to be superior for both types of tests and for both types of material, and the question now arises of superseding the standard rectangular bar, which has hitherto been used in the industry, by a cylindrical bar in specifications. The question also arises of adopting bars of varying sizes to suit the thicknesses of castings represented—a point which the investigation also discloses as desirable.

Alloy Cast Irons.

During the year important research reports were issued on nickel-silicon, chromium-silicon and manganese-silicon cast irons, these forming the most comprehensive results yet issued on these alloys. From them it is possible to state in advance the structure (and hence, more or less to predict the properties) of a cast iron containing any amount of these alloying elements. Important developments have also taken place in the application of these alloys to heat-resisting and other castings as indicated above.

Structure of Cast Iron.

Reference was made in the last Report to the varying structures of irons of similar compositions produced by modifying the conditions of melting. During the year this work has been continued. It was found that superheating or various other forms of treatment resulted in dissolving free graphite in the charges, and that on solidification the metal was composed structurally of fine graphite and ferrite. This structure from the founding and engineering points of view possesses some disadvantages, although the improvement of engineering irons by modification of composition and by better melting conditions with a view to securing the finest type of flake graphite is ever driving the founder nearer and nearer to it. In practice it is difficult to determine the point at which graphite refinement should cease, so the idea was evolved of assuring against risk of producing ferrite: fine-graphite by superheating the melt or by melting graphite-free charges and then furnishing the melt with graphite nuclei by a ladle addition. This ladle addition is a graphite material or a material which provokes the formation of graphite in the melt, and experimentally about a score have been tried. The ladle addition is called an "inoculant" and the iron is spoken of as "inoculated iron," following the original conception that the persistence of the graphite germ in molten iron is responsible for the growth of flake graphite associated with pearlite. Irons produced by this inoculation process have proved to be as strong as any ever made, and commercial production has taken place. During the year efforts have been made to lay the foundations for commercial development by determining the influence of the precise amount of inoculant added, the effect on the process of the temperature of the melt and the effect of the time allowed for the inoculant to act. The results have strengthened the germ theory.

Strength of Cast Iron in Relation to Size.

This investigation has been continued during the year, and the elastic properties of a number of irons have been studied, both in transverse and tensile tests, assistance having been received in the case of the latter from the Brunner, Mond & Company, Limited, branch of Imperial Chemical Industries, Limited. The properties of some inoculated irons have also been studied. Further work has been done on the variation of strength with size of cast bar for pig-irons, refined irons and cast irons, and the results reported in a Paper by the Director to the June Conference of the Institute of British Foundrymen at Birmingham. A number of tests have also been taken on the Tensometer, a small tensile testing machine designed and made in this country to take test-pieces about 0.16-in. diameter. This small size makes the machine very suitable for exploring the strength of the varying sections of a casting.

Recommended Methods of Analysis.

Research Report No. 72 on Recommended Methods for Sampling and Analysis of Foundry Materials went out of print during the year, and a revised and enlarged issue is in preparation by the Tests and Specifications Sub-Committee. During the year the Association co-operated with the National Federation of Iron-founding Employers and the Admiralty in order to determine the most satisfactory tests for improved irons required by the Admiralty, and these are now embodied in the latest specifications.

Foundry Pig-Iron.

The newly-formed Pig-Iron Sub-Committee has given much attention to framing analytical tolerances for use throughout the industry where pig-iron is purchased to analysis, with a view to avoiding difficulties between buyer and seller through small differences which may be due to methods of sampling or analysis. The Senior Metallurgist has visited blast-furnace plants of members in all the principal areas, with a view to reconciling fractures with composition. Speaking generally, it was found that the appearance of a grey fracture with respect to texture or openness or closeness of grain is determined by the distribution of graphite. Furthermore, it was found that irons of similar fracture and varying composition lie on a curve connecting silicon and carbon contents. Thus a fall in silicon content of a pig will give the same fracture if the total-carbon content rises. The relationship is not expressed by a straight line, and any one curve is true only for one blast furnace at one time. A change in conditions (ore burden, melting temperature, etc.) will produce a change in fracture even for the same composition. If, however, the composition alters for metal from the same furnace, irons of the same fracture lie on a curve connecting silicon and carbon contents. From the same furnace fractures corresponding to No. 1, No. 2, No. 3 irons, etc., lie on curves roughly parallel. Interesting comparisons were also made on relative fractures and composition of hot and cold blast irons.

Development Work.

The work of applying research results to practice in the industry does not demand separate consideration, as it has been referred to in appropriate places in dealing with individual investigations. During the year, however, the Research Committee, in reviewing the whole of the activities of the Association, unanimously decided that the programme should, as hitherto, embody both research and development. The function of development work is important in that it assists members to apply the result of the research work in every possible way, and in addition keeps the staff in daily and close touch with the needs and problems of the industry. Hence, by stimulating knowledge of what is required, it has a direct influence on the research programme. It shows the inevitable limitations imposed by commercial conditions on laboratory discoveries. It enables the Association to see what limitations are imposed on progress (for example, in the quality of metal) by weakness in other departments (for example, in melting practice). At the same time, a careful balance has to be maintained between the two sides, and the research work is vital, not merely that undertaken to satisfy a specific need, but also that undertaken with a more general aim. The laboratories have, as previously, performed valuable auxiliary services in connection with research and development. In the chemical laboratory some 3,000 separate estimations have been made, each in duplicate, while in the metallographic laboratory over 800 specimens were examined microscopically, about one-sixth being permanently recorded photographically. In the mechanical testing laboratory about 1,000 mechanical tests were carried out. The laboratories are approved by the Air Ministry Aeronautical Inspection Directorate, for chemical, microscopic and mechanical tests.

Education Committee.

The national education scheme for the founding industry was dealt with fully in the last Annual Report. The Director maintains constant contact with officers of the Board of Education and with other bodies concerned with the scheme, but no meetings of the Education Committee have been necessary. The winter of 1931-32 will very largely determine the response the industry will make to the provision.

Scottish Committee.

The Scottish Committee has not found it necessary to meet during the year, but the demand made on the services of Mr. H. Cowan, B.Sc., Superintendent of the Falkirk laboratory, by Scottish members, is such that it has been necessary to defer the research on light casting irons. It is anticipated, however, that the

results desired in connection with this investigation will be more conveniently obtained from the work proceeding at headquarters.

Annual Meeting.

The ninth annual general meeting was held on October 29, 1930, at the Hotel Victoria, London. At the annual general meeting Mr. W. Turner MacLellan, C.B.E. (Vice-President), presided, and full details of the meeting are given in the "Bulletin" for January, 1931. At this meeting Sir Harold Hartley, M.A., C.B.E., M.C., F.R.S., was elected President of the Association in succession to Major-General Sir Philip A. M. Nash, who was warmly thanked for his services during his period of office. The election of Sir Harold Hartley was carried with acclamation. The annual luncheon was held afterwards in the Edward VII rooms. The address,* delivered by the President, after the luncheon, is also given in the January "Bulletin," and this was followed by short speeches by the Chairman of Council, Major F. A. Freeth and Mr. L. St. L. Pendred.

Finance.

Income and Expenditure.—The total income for the year under review for the first time in the history of the Association exceeds five figures, being £10,110, which is £400 in excess of the previous year. This increasing subscription income has been a characteristic feature of the Association's progress during the past seven years, and has been aided this year by receipts from members in the form of fees for the use of the balanced-blast cupola, the further development of which may be confidently anticipated. The income and expenditure account shows an excess of income above expenditure of over £400; the cost of administration and accommodation have diminished and expenditure on research has increased. The proportion of the total running expenditure diverted to research and development during the year exceeded 77 per cent., the highest proportion yet recorded. The expenditure figures have been made possible by the very highest degree of economy in running expenses and in particular by the severe limitation of capital expenditure, which during the year was less than £80. As has previously been pointed out, the absence of essential equipment and apparatus is a very serious handicap to the Association's activities. Turning to the balance-sheet, it will be seen that the whole of the assets of the Association are valued at nothing and that the total surplus funds at the end of the year were less than £1,300, which is materially less than two months' normal running expenses. The normal lag between the date on which the subscriptions are due and that in which they are usually paid is such that a margin of this character is essential, and hence the Association may be regarded as having no reserve fund.

New Terms of Grant.

The first act of the Council at the earliest meeting held in the year under review was to appoint a Committee for the purpose of considering the situation arising from the change in the terms of Government grant, to operate from July 1, 1931. The Ways and Means Committee appointed on July 2, 1930, was subsequently enlarged to comprise all members of Council representing subscribing members, and its recommendations were formally adopted by the Council on April 29, 1931, and circulated to members. The recommendations were framed to provide for part of the extra income required from the industry to be furnished by existing members and part by eligible non-members who have not hitherto joined the Association. In this connection the Ways and Means Committee kept in mind the very low existing minimum subscription, to which the Department of Scientific and Industrial Research had repeatedly drawn attention. It was decided to raise the minimum subscription to twenty-five guineas per annum, leaving the maximum of 100 guineas per annum as at present. It was agreed that the twenty-five guinea minimum should apply to each foundry in respect of which membership was effected employing up to 250 men; that foundries above 250 should rank for subscription purposes as two units; above 500 as three units, and above 750 as four units, equivalent to the maximum subscription. The unfortunate coincidence between the necessity for these increases at a time of profound trade depression, combined, since the close of the year under review, with the sequence of events which led Great Britain to depart from the gold standard, resulted in a number of members finding it impossible to meet these requirements, and the Council subsequently reduced the twenty-five guinea minimum to fifteen guineas per annum for small foundries employing less than fifty men. It was also agreed that steel foundries desiring membership should be enrolled on the same basis as iron foundries, and in view of the value of the work done in the past it was agreed that members joining after July 1, 1932, should pay an entrance fee equivalent to one year's subscription.

It was decided, in addition, that the Association should establish a fund for the purpose of providing essential equipment and apparatus, the necessity for purchasing which is a constant drain on the Association's slender funds. The Council, therefore, decided to attempt to raise £5,000 for this purpose, not from members, but from manufacturer's associations and other bodies interested in the work of the Association. The Department of Scientific and Industrial Research kindly agreed to regard such donations as grant-earning, and the first subscription received was from the Gas Light & Coke Company, which donated £50 to the equipment fund and doubled its usual trade membership subscription of five guineas.

It is as yet too early to determine what the effect of the changes is likely to be, but it is clear that every effort will be required by the industry in order to carry the Association through the present difficult period. Since the close of the year a delegation representing the National Ironfounding Employers' Federation, comprising the manufacturers' associations on the North-East Coast, South Wales, Scotland, Lancashire and elsewhere, together with the British Ironfounders' Association, comprising the light-castings manufacturers in Scotland and England, has interviewed the Department of Scientific and Industrial Research on the position of the Association and urged the vital importance to the industry of maintaining its work unimpaired.

Membership.

At the close of the year the subscribing membership in all classes was 331, compared with 314 for the previous year. The number of ordinary and trade members is 263, a net increase of 20 on the previous year.

Relations with other Bodies.

During the year official visits were paid to the British Industries Fair, Birmingham Section, and to the Shipping, Engineering and Machinery Exhibition, Olympia.

The thanks of the Association are due to a number of distinguished metallurgists and other gentlemen who from time to time assist it by advice and who take a great interest in its work; in particular to Prof. Sir Harold Carpenter, F.R.S., Prof. C. H. Desch, F.R.S. (who shortly takes up the position of Superintendent of the Metallurgy Department of the National Physical Laboratory recently vacated by another good friend of the Association, Dr. W. Rosenhain, F.R.S.), Principal C. A. Edwards, F.R.S., Dr. W. H. Hatfield, Prof. D. Hanson, D.Sc., Sir William Larke, K.B.E., Mr. W. J. Rees, B.Sc., F.I.C., and Prof. Emer. T. Turner, M.Sc.

The Association was invited to contribute a memorandum to the New Industrial Development Committee, set up by the Prime Minister, of the Economic Advisory Committee to the Cabinet. Of this committee the Right Hon. J. H. Thomas, M.P., is acting as Chairman. The memorandum was circulated to the Committee, and evidence is to be given at a later date by the Association showing steps taken in the founding industry to apply science to industry.

Conclusion.

In spite of the difficulties of the times the Association continues steadily to expand, and its immediate financial difficulties are occasioned by the change in the terms of Government grant, for the state of the industry prevents both existing members from increasing subscriptions to the extent desired and militates against any large influx of new members. The situation is receiving the earnest attention of the Council and the Department of Scientific and Industrial Research, and again the Council appeals for the support of those foundries which have hitherto not become members.

The Report is signed by Mr. H. B. Weeks, the Chairman of Council, and Mr. J. G. Pearce, the Director and Secretary.

* Foundry Trade Journal, November 6, 1930, p. 315.

New Steelwork Association.

At a meeting of the steel structural industry, held on October 30 at the Grosvenor Hotel, it was unanimously decided to form a new organisation called the National Federation of Bridge and Structural Engineers. Mr. James Halliday (of Messrs. Francis Morton & Company, Limited) was elected the first chairman, and Mr. E. A. Willson (of Messrs. Archibald D. Dawnay & Sons, Limited) was elected vice-chairman.

The new federation has a wide field of work before it in the conditions affecting the supply and delivery of steelwork for all classes of public and private contracts. Its formation represents a keen desire on the part of this section of the steel industry to be ready to deal with every phase of economic policy with which the industry may be confronted. At the meeting a programme of work was decided upon and an Executive Committee representing every district in England and Scotland was elected. The members of the Executive Committee are:—Mr. J. W. Baillie (Horseley Bridge & Engineering Company, Limited), Mr. R. S. Benson (Head, Wrightson & Company, Limited), Mr. T. Booth (John Booth & Sons), Mr. A. J. Burgess (John Lysaght, Limited), Mr. H. B. Denton (Joseph Parkes & Son), Mr. J. R. Dixon (Cleveland Bridge & Engineering Company, Limited), Mr. T. R. Miller (Motherwell Bridge & Engineering Company, Limited), Mr. A. Robson (Fairfield Shipbuilding & Engineering Company, Limited), Mr. J. D. Stitt (Redpath, Brown & Company, Limited), Mr. Grahame H. Thomson (P. & W. MacLellan, Limited), Mr. W. T. Thornhill (Rubery, Owen & Company, Limited), Mr. F. G. Woolley (Joseph Westwood & Company, Limited).

The Secretary of the National Federation is Mr. C. J. Kavanagh, Artillery House, Artillery Row, Westminster, S.W.1.

A flux suitable for use when welding Monel metal is a mixture of boric acid and alcohol. Apply this with a soft brush.

Hints for Commercial Visitors to New Zealand.—The Department of Overseas Trade (35, Old Queen Street, London, S.W.1) has published a memorandum containing Hints for Commercial Visitors to New Zealand, prepared from information furnished by the British Trade Commissioner at Wellington. Reference No. C. 3,678.

The Blast Furnace and the Foundry.

The East Midlands Branch of the Institute of British Foundrymen opened its winter session at Loughborough College. The retiring chairman, Mr. T. Goodwin, of Derby, handed over the Presidency to his successor, Mr. T. Spiers, of Leicester.

Mr. Spiers, in the course of his address, asked whether there was anything wrong with the foundry, because it had become the habit with some people to belittle the products and personnel of foundries, and one was apt, speaking generally, to listen to the man making the most noise. He doubted the oft-repeated statement "that we did not get the right type of boys in the foundry," but agreed that this statement meant that we did not get the boys who obtain the greatest number of marks or prizes at school. But the ability of a boy at school was no criterion of his general capabilities or indication of his possible development.

The skill of a good moulder was much greater than was called for in any other branch of the industry, and it was up to every foundry executive to do all possible to develop the interest of the future moulder. The desire for the boys and young men to become better educated emanated from a comparatively selfish point of view. As it was necessary to make certain that there are youngsters coming along able to make better castings, with less trouble and at less cost than before, founders should, therefore, be prepared to make sacrifices and allow those boys and young men opportunities, even if it cost them something.

If the present disabilities are to be removed, the authorities must make the foundry training more palatable, and instead of just feeding students with facts and figures, they must take care of the student in his social life by arranging the possibilities of sport and recreation as well as study. A class of friends will go much farther than a class of units. Having achieved these points, they must provide a college where students enter by examination and live for an arranged number of terms to enable them to qualify for the best positions a foundry can offer. They would then have removed the major troubles that arise in foundries to-day.

Foundries will always have trouble in producing castings in any metal, but the aim and effort of the Institute, and the Branch in particular, should be to reduce these troubles to a minimum by pooling experiences and knowledge, and by being prepared where necessary to sacrifice something for the benefit of the industry. The Institute will then have removed the necessity of asking the question, "Why is there anything wrong with the foundry?"

In conclusion, it may seem a long vista to the time when the foundry student leaves the foundry, goes to his evening or afternoon class, baths, changes his clothes, has a light meal and then to study for a time, the remainder of the evening spent in sport or recreation; followed by examinations, which will enable him to take his two or three years at college, from which he would emerge a fully-qualified foundry executive, with a worth-while degree; but it is an ideal worth trying for.

Discussion on Blast-Furnace Practice.

After the chairman had been accorded a vote of thanks Mr. R. A. Hacking presented a Paper entitled "A Few Notes on Modern Blast-Furnace Practice," in the course of which he presented a mass of data concerning the effects of hot and cold blast and dry air in blast-furnace operations.

Mr. P. A. Russell (Leicester) said the Paper was intended to be the commencement of a series of lectures to cover the process of iron manufacture from the ores in the blast furnace to high-duty cast irons, and in this respect the Paper hardly covered the complete field. What were the essential factors that graded the pig-irons used in foundry practice? The blast furnace would produce varying grades of iron from an open No. 1 to a close forge. Why did the blast furnace, under certain conditions, produce high-silicon irons, and then low? What controlled the carbon in the irons, and the size of the carbon in the graphitic state? Cold-blast irons were superior to hot blast, due to the smaller graphite flakes. It was nowadays essential to have good pig-irons, yet since the war there had been a falling-off in the quality of pig-irons, and could Mr. Hacking give any explanation of this deterioration? He was sure that if, at a slight extra cost, the furnaces could produce the good old quality irons, they would find a ready market.

Factors Governing Carbon and Silicon Contents.

Mr. Hacking said he did not realise before that the Paper was to be one of a series of three Papers mentioned. Had he known, he could have prepared a Paper on "Blast-furnace Practice" to give the general working methods of producing foundry pig-irons, which, no doubt, would have answered the purpose. With regard to the grading of pig-irons, the grading in the past has been done by fracture, and there were still many people who relied upon this method. Fracture varies according to the silicon content. The factor that governs the silicon content is the temperature of the iron in the hearth. All phosphorus charged appeared in the pig-iron. In the case of sulphur, the higher the lime in the slag the lower the sulphur in the pig-iron. The amount of carbon in the pig is not dependent on the temperature of the furnace. At melting point, pig-iron can only absorb 4.3 per cent. carbon. The amount of carbon varies when other elements are present. The higher the silicon, the lower the total carbon. When the pig was molten, all carbon was in the combined state. As it cooled off, graphite separated. The quicker the cooling rate the smaller the graphite flakes, and the higher the silicon content the larger the graphite flakes. In the case of cold-blast irons, they required the use of well over two tons of coke per 1 ton of iron produced, as against 26 cwts. of coke per ton of iron in the case of basic irons. There must be something of value in cold-blast irons. Cold-blast iron had a much greater volume of nitrogen than had hot-blast iron, and perhaps the amount of nitrogen is a potential explanation. With regard to the deterioration of hot-blast irons, he did not agree that such was the case, and probably one was apt to look back on the past with a kindly view.

Mr. T. Goodwin said that in his younger days he spent a great deal of time around a blast furnace. If one passed the furnaces to-day one saw huge stocks of old corporation tins, and he was wondering whether pig-iron was made from ores or from the tins. As to Mr. Russell's remarks as to the deterioration of irons, that was certainly the case, and foundrymen had to produce a better material. A few years ago the strength of cast irons was round about 9 tons per sq. in. tensile, while now it was 14 tons. So it did put the foundrymen in an extraordinary position, as the pig-irons of to-day were not so good as they were.

Mr. Hacking said he could only suggest the use of the tins as economy. He knew foundrymen liked an all-mine pig-iron. The use of tins and cinder does not influence the composition of the pig-irons. The iron content in the ores used for basic irons was approximately 26 per cent. of the burden, and is boosted up to 34 per cent. by the use of cinder, etc. In the case of foundry irons, the higher the cinder, etc., the higher the proportion of iron in the burden. It does not influence the carbon, silicon, manganese or phosphorus contents of the iron at all. So far as the use of scrap tins went in the blast furnace, there was no detriment in using small amounts. He, personally, would far sooner use ores, but with the scrap so cheap, it was used from the point of view of economy.

Mr. Goodwin asked why should not a scrap burden be so good as an ore burden?

Mr. Hacking replied that the scrap went through the furnace without nitrogen. In the case of all-mined, a certain definite amount of nitrogen goes through the furnace. Therefore, the nitrogen is lower when using scrap. He thought this might be the reason, but had no definite proof.

Mr. Stevenson (Nottingham) gave an instance of some trouble he had experienced due to segregation in 6-in. high-pressure globe valves. At the same time, a parcel of purchased scrap iron contained an identical 6-in. valve that had been in work for the past 20 years. This valve was broken and examined, and no trace of segregation was noticeable. Mr. Stevenson then had this metal analysed in the hope that the analysis, when compared with his own metal, would indicate some reason of the cause of his defects. He was very much surprised to find that the valve was made in common irons, the analysis being very similar to that to be obtained by the use of Derbyshire pig-irons. He was wondering whether by running the blast furnaces at high speed the iron was melted or "fried"?

Mr. Hacking said oxidation was definitely impossible. Was there any pronounced difference in the analysis of the valve taken from the scrap-heap, and those which Mr. Stevenson was having the trouble?

Mr. Stevenson explained the phosphorus in the scrap-heap valve was 1.6 per cent. as against 0.8 per cent. in his mixture, whilst the manganese was 0.5 per cent. as against his 1.0 per cent. According to modern practice he was using the better iron for high-pressure work.

Mr. Hacking illustrated, by blackboard sketches, two types of segregation he had found in steel ingots. The one known as "piping" that was definitely due to contraction, and the other that was due to blowholes from gases, and asked Mr. Stevenson if he could define the type of segregation encountered in the valves.

Mr. Stevenson replied that the segregation was the type that made for porosity in high-pressure castings in the thick sections, and was probably due to excess of phosphorus content.

Mr. Hacking would not like to commit himself to a theory of the trouble without seeing the actual castings.

Mr. King (Nottingham) suggested the type of porosity mentioned by Mr. Stevenson was due to the size of the graphite flakes. If the graphite was in the large flaky form, porosity would occur. The graphite should be split into the fine curly nature. In his works, for high-pressure castings he purchased the irons to fracture and analysis, which was a more suitable method than by analysis alone. One could not expect to get close-grained castings from open-grained pig-irons. However, if one would carry the temperature of the cupola up to blast-furnace temperature it would tend to break up the graphite flakes.

Vote of Thanks.

Proposing a vote of thanks to the lecturer, Mr. E. Stevenson explained the idea of the present series of lectures. It was one suggested by the President, Mr. Spiers. In previous sessions they had had Papers on various subjects, and Mr. Spiers thought that finality was not reached. He therefore proposed that this year the lectures would take the subject of iron from beginning to end in a series of three. This lecture on the blast furnace was No. 1. The second Paper would be on cupola melting, and the November meeting would be on high-duty cast irons, whilst the December meeting, to be held in Nottingham, would take the form of a summing-up of the three Papers.

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Low Total-Carbon Cast Iron.

MANY ASPECTS REVEALED IN DISCUSSION.

MR. W. WEST, of Leyland Motors, Limited, presented, at the October meeting of the Lancashire Branch of the Institute of British Foundrymen, a Paper on "Low Total-Carbon Cast Irons and Their Service to Foundrymen."* Mr. Roy Stubbs, the Branch-President, occupied the chair.

Fluidity and Composition.

MR. S. E. DAWSON, opening the discussion, asked whether Mr. West had found that in the low total-carbon cast irons segregation of sulphur and phosphorus was checked or minimised. His own experience was that segregation had definitely been prevented, with rather better results in strength and machining property. That was what one would expect in view of the shorter period of the formation of the eutectic. Could Mr. West tell them anything about the total carbon and silicon in relation to fluidity? On the question of the germ theory, or inoculation theory as it might be termed, the temperature tests, if Mr. West took them, would be very interesting. He thought there was no question that in the low total-carbon irons the effect of the temperature was important to help to remove shrinkage troubles.

MR. WEST said that he had pointed out that the sulphur was down to between 0.04 and 0.06 per cent. and the phosphorus ran from 0.2 to 0.4 per cent. Microscopical examination had not been made as yet on all the samples, but they were hoping to continue their investigations, and reap the benefit of the experiments which had been done, so at the moment he was unable to speak with any authority regarding the segregation of sulphur and phosphorus with low total-carbon contents. Off-hand he would say that if they had higher phosphorus and sulphur contents, the segregation of these would be more evenly distributed by reason of the shorter freezing range. With regard to the total carbon and silicon, they had not taken any tests like those Mr. Dawson apparently had in mind. He had purposely kept pure theoretical matters out of the lecture, because he thought foundrymen could visualise things better, or appreciate things better, by seeing the actual things instead of troubling with curves and graphs. Shrinkage determinations were being collated from these experiments.

The Germ Theory.

Regarding the germ theory, the members would notice that, in some of the fractures, superheating to 1,450 deg. C. had produced a blackening of the fracture due to the carbon being more finely distributed throughout the iron. It had to be borne in mind, however, that the germ theory provided for the addition of calcium silicide, or some similar agent, to the molten metal at a certain period, in order to precipitate from a super-saturated metal the excess carbon. In view of this fact the high-temperature melts were not strictly in accordance with the provisions of the germ theory. Therefore, he could not, in any detail, give definite information, one way or the other, as to the reaction obtained by using the "germ theory." He could only emphasise that the experimental melts in the crucible had not shown any diminution of the liquid-shrinkage effect over the cupola-melted metal. He could not, therefore, agree that superheating was any material help in the removal of the trouble unless an alteration to the total-carbon content was also made.

Influence of Manganese.

MR. J. A. REYNOLDS asked whether Mr. West, in his experimental work, had tried the effect of manganese. They knew that manganese, outside certain limits, gave a spiky fracture which was detrimental to wear resistance. Did Mr. West control it, vary it or ignore it?

MR. WEST said their usual practice was to have 0.8 to 0.9 per cent. manganese in the final mixture. He was of the opinion that manganese did help to increase the resistance to wear of cast iron. It was similar in its action to a chromium addition, inasmuch as a definite carbide was formed. An increase of manganese to 1.5 to 2.0 per cent. would not be detrimental, providing the other elements in the mixture were made suitable for machining purposes. It was hardly possible, in view of its influence, to ignore this element, and every attempt was made to control the content as far as possible.

MR. A. BRIERLEY said that he had never been able to obtain Mr. West's figure of 2.55 total carbon. Even when melting all steel in the cupola the total carbon ran over 3 per cent. By careful working they at times got down to about 3 per cent., but with ordinary cast iron the 2.55 per cent. was remarkably low. If he read the slides right, it was cupola-melted metal and not crucible-melted. A point had been raised about high-manganese content. He thought it would only increase the difficulty in making the particular cylinder block which was put on the screen. The high-manganese irons usually shrank a good deal more than a low-manganese iron. In that connection, Mr. Dawson's remarks about the temperature of casting helping to remove shrinkage trouble were very applicable. Possibly an increase in the casting temperature would result in a sounder casting. In relation to the resistance to wear of cast iron, had Mr. West considered what the effect would be of a small increase of phosphorus over the 0.4 per cent. mentioned? Phosphide of iron was very hard, and, as far as resistance to wear went, he thought a slight increase of phosphorus would be an advantage, provided it did not weaken the iron so much that it would not stand the high-service temperatures.

Carbon Pick-up during Melting.

MR. WEST said he had omitted to mention that his cupola experiments were carried out in a baby cupola producing 20 cwts. of iron per hr. They aimed at 2.75 per cent. carbon and obtained 2.55 per cent. It was produced by using a 100 per cent. synthetic iron made in the electric furnace, having an analysis of 2 per cent. total carbon and 2 per cent. silicon. The 0.5 per cent. was picked up through the small baby cupola; in a large cupola they were never able to get above 2.9 per cent., when using steel alone. Regarding manganese and shrinkage, from the fact that manganese formed a carbide, it might be theoretically assumed that it would accentuate the shrinkage effect, but he had not carried out any experiments in this direction. He did not know what Mr. Brierley meant by "high manganese." Personally, he should not call 1.2 per cent. high. If that was what Mr. Brierly had in mind, he would say at once that it had no marked effect of increasing liquid shrinkage. Higher casting temperature did not do away with liquid shrinkage. From the crucible they obtained 1,450 deg. C. pouring temperature, and for the benefit of the members he had brought a number of actual specimens; there were other types of casting, but these were most handy in form to bring along to show the effect of the pouring temperature of 1,450 deg. C. The increase of temperature to 1,450 deg. C. had had no effect whatever on the shrinkage.

He had quite an open mind on the matter of phosphorus in relation to wear. They themselves ran with 0.8 to 0.9 per cent. phosphorus for quite a long time. But before it could be definitely stated that phosphorus helped resistance to wear or *vice versa*, a multitude of experiments must be made, and one had to wait months before any practical result was obtained.

Silicon Variations.

MR. A. JACKSON remarked that he was glad Mr. West had not used difficult phrases to the complication of the subject; some experts were difficult to follow by those they were supposed to instruct. Mr. West would do a great deal to help the men in the foundry if he kept on the lines of the present lecture, thus enlightening the men who were not metallurgists. One thing about the graph thrown on the screen showing the silicon and carbon appealed to him as being very interesting. The line for the silicon was lowest on Monday morning, but rose gradually until Friday night. Then on Saturday morning it dropped. What appeared to happen in a foundry was that the furnace started from cold on Monday morning, and gradually as it warmed up they got better results. It was a curious fact that they seemed to get the best iron on the Friday afternoon; Saturday was a short morning, and taking only the morning blow, they probably did not get the same temperature. Of course, if the temperature were raised, more silicon remained in the iron, sulphur passing out in the slag. In a cold melt the tendency was for a rise in sulphur and loss in silicon. These two points seemed to be strikingly illustrated in the graph.

Years ago, in a casting which ought to have been perfect on the underside, he observed a draw there. There was a depression almost as if a thumb had been pressed into the casting. That seemed to be a shrinkage, but there was something that was not consistent with the ordinary idea of shrinkage. They were told that instead of putting facing sand underneath the pattern they ought to use ordinary black sand. It was insisted that that was what they ought to do, and they did it. A quicker way and just as safe was to increase the depth of facing sand. It would appear in the first case that the black sand allowed air to escape from the mould freely; and in the other case the extra red sand or the facing sand stopped the air from going through to some extent, but did not cause the air to work back into the mould.

MR. WEST, in replying, asked to be shown the graph to which Mr. Jackson referred. He then pointed out that the figures varied so little from day to day that it could be hardly said that they increased to any appreciable extent by the end of the week. If better iron was produced at the end than at the beginning of the week the obvious explanation is a lack of efficient control. Good and hot metal all the time was imperative, if satisfactory castings were to be produced. Silicon variation occurred more often than not through an indifferent quality of the scrap used in the cupola mixtures. Sulphur did not present any difficulty to the foundrymen when the manganese content was sufficiently large to take care of it. The particular case of trouble referred to by Mr. Jackson seemed to carry every evidence that the source of it could have been in the metal and not in the type of moulding sand used. While admitting that permeability of moulding sand was an important factor, it was not the source of shrinkage trouble as described.

Hardness and Section Thickness.

MR. A. SUTCLIFFE said that if a man in breaking up a cylinder broke off the foot, or a piece off at the jacket, or he took a piece out of the barrel, did he expect to get the same total-carbon and graphite content in all three parts? The barrel was much thicker. If he used low-carbon and also low-silicon iron, the foot and jacket were going to be white iron, *i.e.*, if he took the analysis of the barrel, as the barrel was the thickest part of the casting. These low-carbon and low-silicon irons were satisfactory for the barrel to a certain extent on account of withstanding wear, but the foot and jacket had to be

* FOUNDRY TRADE JOURNAL, October 29, 1931, pp. 272-5.

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machined; the metal in these two would be much harder, although it was all one casting.

Mr. West replied that it was to be expected that the thicker barrel section of a cylinder casting would differ in structure from the jacket walls, which in most cases were reduced in thickness to a minimum. The foot portion was usually about the same sectional thickness as the barrel walls, and because of this very little difference was noticed. What they aimed at was to get the structure of the walls correct, because of the important part it played in deciding the life of a cylinder block. The walls of the jacket could be produced under these circumstances without any signs of whiteness in the fracture, but to effect this, a very fine control upon the chemical analysis must be made.

Superheating Cast Iron.

Mr. Dawson agreed that the pouring temperature, and possibly more so the melting temperature, had a big influence on the segregation. It was quite possible also that there would be a difference in the resistance to wear between metal taken up to 1,450 deg. C. and metal which went above that and was then reduced to 1,450 deg. C.

Mr. West said that the temperatures given in the graph were taken at the time of pouring, so that the initial temperatures must have been at least 50 deg. C. higher. The superheating of cast iron was occupying his attention at the moment; they would go on with it if it gave better results than were now obtained from the straight cupola iron, but he had an idea that with superheat they would not get the resistance to wear which was suggested. Dr. Piwowarsky had indicated that superheat was accompanied by dissociation of the pearlite and with a resulting separation of soft iron. It was necessary, therefore, to be very careful and very conservative as to what they were to expect. The cupola had been with them for many years and would be with them for many more years. However, if there were better and reliable methods of production than the cupola, the sooner they came into use the better for foundrymen, providing such were within the means of the foundry to purchase and make an economic proposition.

Mr. J. S. G. Primrose said that the problem of getting good cast iron to withstand the high duties now imposed upon it was reduced to a question of the proper microstructure. In every case the cast iron which behaved best was one in which they had an all-pearlite matrix, achieved chiefly by the correct composition and casting temperature, so that the graphite flakes were small and curly. Some day they would have to turn to an all-sorbite matrix as still better than pearlite, as other ironworkers have had to do, as in high elastic-limit ship plates and high-tensile wire. The resistance to abrasion could most easily be measured in the workshop or in the laboratory by means of the Amsler abrasion-testing machine, which could be seen in Birmingham to-day.

Mr. E. Longden said at one time they made bearings for large gas engines in a common Midland iron containing approximately 0.45 manganese, 1.3 phosphorus and 2.5 per cent. silicon, which, on remelting with scrap, gave about 0.4 per cent. manganese. These bearings were known to stand up well in service. During the war some bearings were made in a metal with low phosphorus and silicon and higher manganese, approximately 0.75 per cent., on the request of a Government inspector. Castings made in such special iron lasted only a few hours under similar service conditions, and were eventually replaced with the common low manganese, high phosphoric iron. Mr. Longden had repeatedly had a grey cast iron containing silicon 2.0 per cent., phosphorus 1.0 per cent., manganese 0.35 per cent. and sulphur 0.12 per cent., which was machined with great difficulty. This showed the bewildering and complex nature of cast iron.

Mr. West said he hoped to lecture in February before an engineering institute on "Resistance to Wear in Relation to the Structure of Cast Iron." Up to now the consideration had always been the resistance to wear in relation to the chemical composition, but he was now considering the question in relation to the structure. By casting successively thicker bars, he thought he could get the decomposition of the pearlite and have the same composition, and thereby altering the structure as the thickness of the bar increased.

Newcastle Foundrymen Visit Norwood Coke Works.

The Newcastle and District Branch of the Institute of British Foundrymen visited the Norwood Coke Works, Dunston-on-Tyne, by kind invitation of the directors of Priestman Collieries, Limited, on October 24. The visitors were met by Mr. Peel, director and general manager, Mr. Curry, manager of Norwood Works, and Mr. Witton, manager of the home trade department.

The Norwood Coke Works.

The coal storage at the Norwood Coke Works consists of 46 bunkers, each capable of holding 90 tons of coal. The coals are mixed in standard proportions, crushed and then charged into the ovens. A Campbell Binnie jig washer is used for washing a proportion of the coals. There are two batteries consisting of 60 ovens each and one battery of 10 ovens, the ovens being of the Otto regenerative type. The coals are carefully selected, tested and blended, each step in the process being controlled by the laboratory. The resulting coke is strong and tough. The time of carbonisation is 29 to 30 hrs. After quenching the coke is passed over jigger screens and loaded into trucks by an adjustable loading table, which ensures a minimum of breakage.

A special feature of the works is the production of coke nuts for foundry, domestic and other purposes. The coke nuts are actually cut from the large pieces of best coke. The advantages of the cutting process are:—(1) The resulting coke nut is roughly in the shape of a cube, which has a large combusting surface; (2) the cutting action breaks the coke at existing cross fractures, and the limit of breakage having thus been reached further breakage will not occur in transit or in handling, and there will be little formation of fines; (3) the grading is more uniform. This is a most important point where quick melting is required in tilting and pot furnaces; and (4) the user is saved the cost of labour in breaking. If the user breaks the coke at his own works, fines would also be made, which are useless. This represents an economy of at least 10 per cent. These advantages ensure economy and regularity in the working of the furnaces or fires. The sizes cut are ½ in., ¾ in., 1 in., 2 in. and 3 in.

Exhausters draw away the gas from the coke ovens to the by-product plant, where the various by-products are extracted. Approximately 47 per cent. of the gas is returned underneath the ovens for heating the oven walls. The remaining 53 per cent. is sent to the power stations for steam raising. Tar is produced by spraying the gas with ammoniacal liquor or water, which drives out the tar globules. The ammoniacal liquor is the moisture which has been driven out of the coals during the coking process and collects a small proportion of ammonia from the gas as it travels through the mains to the by-product plant. The tar thus obtained is taken to another part of the works and treated in a distillation plant for the recovery of creosote oil, anthracene oil, pitch and also for the preparation of road tars.

The gas, after leaving the tar extractors, is bubbled up through a saturator filled with sulphuric acid, where the ammonia is precipitated. It is then ejected to a copper pot and whizzed in a centrifugal machine to drive off the moisture, thus producing sulphate of ammonia, another of the by-products. Naphthalene has to be recovered from the gas to ensure its purification. The gas enters two naphthalene spray coolers at 50 deg. C., cold water is then sprayed on the gas and the sudden chilling and condensing arrests the naphthalene.

The gas is then pressed through scrubbers, creosote oil being circulated to absorb the benzol from the gas. The temperature of this benzolised oil is then raised by passing it through heat exchangers and superheaters. During this process a certain amount of the benzol vapours are driven off. The benzolised oil is then brought into contact with live steam in the benzol still. The benzol and steam vapours are then condensed and enter a separator, the benzol running to a storage tank and the water to waste. The benzol is in a crude state and is taken to another of the Priestman works for rectification.

Ash Content in Coke.

After being conducted round the works, the party was entertained to tea by Priestman Collieries, Limited.

Mr. Curry said that it had been a great pleasure to have the members of the Institute of British Foundrymen inspect the works that afternoon; there had been many old friends there again. He had been at the Norwood Works for 17 years, and the Branch had paid three or four visits in that time. He hoped that they had had an enjoyable afternoon, and had seen something fresh that would help to stimulate their ideas about coke and its uses. The foundry trade was linked up with coke makers, just as shipbuilding was as well. The manufacture of coke had attained a very far-reaching stage. About 40 years ago it mattered very little whether the ash content of coke was 9 or 12 per cent., but the progress of science had been so rapid within the last few years that it was essential that anyone connected with coke and its by-products should put on to the market the very best articles possible. They had seen that afternoon, works which were equipped for that purpose.

Foundrymen had to have the right products to work with. It was, therefore, essential to have coke with very low ash content and also easily combustible, and which would ensure satisfactory melting of the burden in the furnace. Priestman Collieries had striven in the last few years to meet that market, and they were able to produce a coke consistently of a stable analysis. They could guarantee that coke would not contain more than 6 per cent. of ash and 0.7 per cent. of sulphur. If a foundryman knew that the ash would be 6 per cent. constantly, he would burden the furnace to suit, and would not need to adjust the fluxing arrangements from day to day.

Vote of Thanks.

Mr. Allan, in proposing a vote of thanks to Priestman Collieries, Limited, and their staff for their courtesy and hospitality, said that if anything ought to interest foundrymen it was the manufacture of coke. The members of the Newcastle Branch greatly appreciated the kindness of their hosts, who had given up their leisure to show them the works.

Mr. Gresty, supporting the vote of thanks, said that Mr. Curry had mentioned the seeing of several old friends present; it was the speaker's third visit to the works, and he hoped it would not be his last. Next month the Branch was having a joint meeting with the Coke Oven Managers' Association. He was sure that he would be expressing the wishes of the Branch if he said that they would be exceedingly glad to see Mr. Curry and his associates at the meeting. The discussion would be upon "Coke for Foundry Purposes." That afternoon the foundrymen had visited a typical coke works, and the Coke Oven Managers' Association had, incidentally, done the same thing. About ten days before they had visited the North Eastern Marine Engineering Company, Limited, to secure some knowledge of the foundry side of the question, so that a good discussion was expected.

Operating an Iron Foundry Without Pig-Iron.

By Walter Lister.

In these days of keen competitive prices, it is more than ever necessary to take advantage of every possible means of reducing production costs. In no branch of the industry is this more evident than in an iron foundry. But even after everything conceivable is done, all charges cut down to a minimum and output boosted up to the maximum, the cry still goes forth, "We cannot compete at the price." Then it is time to examine the equipment.

Under ordinary cupola practice, where melting is not continuous, it will be found that a point has been reached where, in order to make any further improvement, considerable more floor space will have to be provided. But this, for many reasons, will probably be undesirable and perhaps impossible. But still, in order to save the business, it is necessary to obtain a much greater quantity of castings from the same floor space. The problem is: How can it be done? It can be done by installing an electric furnace and working it on the continuous-melting principle.

By means of an electric furnace, any quantity of iron can be poured at any time during the day, and the same floor space and moulding equipment can be used a number of times during the day. This considerably increases the output of the original floor space, and at the same time considerably decreases the cost of moulding equipment necessary.

Furthermore, it is possible, by means of the electric furnace, to use much cheaper materials than can be profitably employed in the cupola. For instance, it is not necessary to use any pig-iron at all in the electric furnace; the charge can be made up entirely of cast-iron borings, foundry scrap and steel scrap. Borings cannot be profitably used to any large extent in the cupola, but they may compose the major portion of the electric furnace charge.

Many varieties of steel scrap, such as sheet clippings, which at the present time are not worth the cost of bundling, can be utilised to advantage in the electric furnace. All classes of steel turnings also can be obtained very cheaply. These materials, together with the necessary additions of ferro-silicon, ferro-manganese, carbon, etc., can be converted into a high-quality grey iron at a much lower cost than it was possible to obtain previously in cupola practice, assuming, of course, that the cost of power is not excessive.

But even in this case, if high power costs make the total cost to equal that of the cupola, a considerable saving is effected owing to increased output, fewer rejections, etc.

Method of Working.

To obtain the best results, the working must be continuous, that is, continuous tapping and charging must take place. In order to do this, it is first necessary to prepare an initial bath of iron as a nucleus. The charge for this can be put in after tapping and drying up the day before. Taking as an example a furnace of 10 tons capacity, this initial charge would consist approximately as follows:—Borings, 35 cwts.; foundry scrap, 5 cwts.; and steel scrap, 20 cwts.; total initial charge, 60 cwts. As a charge of this composition will melt at approximately 1.50 per cent. carbon, if a higher carbon content is required, it will be necessary to add it in the form of ground coke or anthracite coal. This can be put in with the charge so that it is incorporated in the melting down.

About three tons only should be melted down in this initial charge, and when the operation is complete and the bath up to temperature, more borings, steel scrap, and the requisite amount of coke dust can be added at intervals until a charge of 10 tons is built up. When this is well melted it should be carefully rabbled and a sample poured for analysis. When this is known, the bath can be regulated according to the specification required. If the carbon is too low, the slag should be raked off the surface of the charge, and more ground coke thrown on. If too high, more low-carbon steel scrap can be introduced. Silicon and manganese also can be added in the form of ferro-silicon and ferro-manganese respectively. Phosphorus can also be added, if required, in the form of ferro-phosphorus.

When the analysis and temperature are correct, tapping can commence. It can be arranged that the first iron shall be tapped off at, say, 7.30 a.m., to fill any moulds left over from the day before. In this case some of the original three tons may be tapped before the full charge is made up.

After tapping any quantity, a feed charge should be put in according to the amount taken out. A feed charge will take about 30 min. to melt. With each feed charge, about 1.00 per cent. of ground coke or coal should be added in order to keep up the carbon content. Towards the end of the day, requirements should be carefully calculated so that the last batch will empty the furnace.

During the day's run, the analysis should be carefully checked so that a uniform quality of iron can be maintained. The temperature also should be carefully regulated from time to time. This can easily be done by means of any standard optical pyrometer. It is this ability to control analysis and temperature within fine limits which gives electric cast iron the characteristic of being most unvarying in its consistency.

Table I will give an idea of the present-day cost per ton of electric iron compared with that of cupola-melted material.

Table I.—*Cost per Ton of Electrically- and Cupola-Melted Iron.*

	£	s.	d.
Electric Melting.			
14 cwts. cast-iron borings at 25s. per ton		17	6
5 cwts. steel turnings at 27s. per ton		6	9
1 cwt. foundry scrap at 45s. per ton		2	3
5.00 per cent. melting loss		2	6
500 kw.-hrs. at 0.63d.	1	6	3
Furnace labour		4	6
12 lbs. carbon electrodes at 3½d. per lb.		3	6
Refractory costs and depreciation		2	9
Ferro-alloys, coal, etc.		4	2
	3	10	2
Cupola Melting.			
10 cwts. low phosphorus and sulphur pig at 62s. 6d. per ton	1	11	3
5 cwts. cast-iron scrap at 45s. per ton		11	3
5 cwts. cast-iron scrap at 45s. per ton		11	3
6.00 per cent. melting loss		4	3
1½ cwts. foundry coke at 20s. per ton		1	6
Labour, fluxes, refractories, blast, etc.		13	7
	3	13	1

From the foregoing it will be seen that electric cast iron can be made more cheaply than the cupola product, and so far as quality is concerned, it has been found that the former gives much better results. A greater control can be exercised over the analysis and melting conditions. The temperature of the metal may be raised to any desired extent, and the sulphur and oxygen content reduced to very low limits. The high temperature is beneficial inasmuch as it tends to throw all the carbon into solution and retard the formation of large flakes of graphite, the latter being found in the casting very finely divided and evenly distributed. Another beneficial result of the high temperature is that it produces a uniform structure in the iron itself which can be noticed in its improved machining and wearing qualities. The embrittling effect of high phosphorus is also rendered unnecessary as electric iron can be rendered fluid enough to run the most intricate castings.

Table II.—*Comparative Tests of Electrically- and Cupola-Melted Cast Iron.*

	Electric.	Cupola.
Transverse strength (lbs.) ...	4,740	2,950
Tensile (tons per sq. in.) ...	27.9	19.7
Deflection in inches	0.135	0.10

To sum up, without using a pound of pig-iron, a better quality of grey iron can be produced in the electric furnace than that obtained from the cupola, and at a cost equal, if not lower, than that of the cupola product, to say nothing of the greater output from the same floor space and convenience of tapping any desired quantity as required.

An Editorial Criticism.

Mr. Lister's article presents several points of interest. Primarily, the comparative strengths of 27.9 and 19.7 tons all require elaboration before acceptation. The composition of both would be required. The outstanding feature is that any ferrous material breaking at 27.9 tons per sq. in. would require steel moulding practice, with an additional cost not shown. Moreover, the size of test-piece, where taken from and how cast are also essentials for comparison. Information is also desirable as to the machinability of such material. A further question is whether the iron could be kept hot so as to cast a 20- or even 30-ton job.

Having at our disposal a vast experience of electric-furnace melting, we are just as enthusiastic as the author, but we still feel that at the moment the best field for its application in the iron foundry is as a duplexing unit for the adjustment of composition and the superheating of the metal; but we confess that the figures submitted are so convincing that a closer investigation is warranted. Exceedingly low-carbon cast iron must at the same time justify itself as costing no more to mould successfully than the higher-carbon material.—Editor.

When welding Monel metal by the metallic-arc process, the work must be made negative instead of positive.

Austrian Magnesite Trade.—Figures for the first eight months of the current year show exports of magnesite from Austria to be still greatly on the decline. In regard to sintered magnesite the exports for the period were 16,700 metric tons, as compared with 36,500 metric tons in the first eight months of 1930. Trade with the United States during the period, which amounted to 27,000 tons during January-August, 1930, was only 510 metric tons this year. The loss of the American market is a severe blow to the Austrian magnesite industry, whose total exports, which were valued at 14.5 million Austrian schillings in 1929, and 9.3 million schillings in 1930, were only worth 1.7 million schillings during the first half of the present year. It is worth noting that Germany, which only took 521 metric tons of Austian crude magnesite in the first eight months of last year, took 3,322 metric tons during the corresponding period of this year.

Growth of Cast Iron under Tensile Stress.

EUGEN PIWOWARSKY and OTTO BORNHOFEN, in a communication from the Foundry Institute of the Aix-la-Chapelle Technical High School, published in "Archiv für das Eisenhüttenwesen" for September, give the results of tests on the growth of cast iron under tensile stress. Whilst cast iron in service can undergo alterations in volume at temperatures from 200 deg. C. upwards, laboratory tests show it to be practically constant in volume up to about 550 deg. C. Among the causes suggested for this variation is the occurrence of alternating loads in cast-iron constructions and machine parts.

The present experiments were carried out on round test-bars 5 mm. dia. and 150 mm. long between the heads. The bars were suspended in resistance furnaces and loaded by placing suitable weights in a pan hanging below them. Additional heating elements were attached to the steel adapters carrying the test-pieces which gave a uniform temperature over the length of the pieces within 5 deg. C., even at 650 deg. C.

Six different materials were used in the experiments, of which three cast irons were prepared at the Institute with increasing silicon and diminishing manganese contents (A, B and C), while the others were supplied by the United Steelworks Company, *i.e.*, an electric iron (D), an iron prepared by the Thyssen-Emmel process (E), and an iron taken from a pig-iron mixer (F). The compositions of these irons were as shown in the table.

Contrary to earlier preliminary experiments carried out by the authors with less reliable apparatus, which had indicated growth at a temperature of 250 deg. C., an appreciable elongation was first obtained above 600 deg. C., under a load of 1 kg. per sq. mm. Higher loads produced greater elongations, but the tests up to 500 deg. C. led to the conclusion that the elongations observed on test-pieces A, B and C were purely due to static extension under load. Actually, even after 90 hrs. heating with a load of 5 kg. per sq. mm. at 500 deg. C., identical elongations were obtained with the materials A and C in spite of the great difference in the silicon contents. Differences in permanence of volume were first found above 600 deg. C. under load. At 650 deg. C. a load of 2 kg. per sq. mm. caused fracture of the pieces in 12 to 16 hrs. At this temperature a load of 1 kg. per sq. mm. was sufficient to show a tendency of the bar to grow, the alterations in length obtained being 10 to 20 times those without load.

Description.	Total C.	Graphite.	Si.	Mn.	P.	S.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
A (cast iron) ..	2.75	1.71	1.07	0.43	0.073	0.019
B („) ..	2.46	0.97	1.59	0.12	0.074	0.032
C („) ..	2.58	1.34	2.84	0.08	0.088	0.035
D (electric iron)	2.84	1.98	1.57	0.86	0.197	0.048
E (Emmel iron)	3.04	2.23	1.76	1.14	0.141	0.083
F (mixer iron)..	3.35	2.93	2.03	0.50	0.723	0.026

Similar results were obtained with iron bars D, E and F made under works conditions. The tests at 400 deg. C. and 5 kg. per sq. mm. already gave values indicating a tendency of the bars to grow, but the differences in the behaviour of the materials only began to show at 600 deg. C. and 650 deg. C. Here also a load of 2 kg. per sq. mm. was too high, the mixer-iron bar breaking after 16 hrs. at 650 deg. C.

The great differences in the elongations, which were in the order expected from the analyses, led the authors to propose the adoption of heating for 20 hrs. at 650 deg. C. under a load of 1 kg. per sq. mm. as a short-time test of growth.

As already mentioned, the elongations at temperatures up to about 500 deg. C. were purely due to static loading, and were independent of the composition and method of manufacture of the irons. Considerable differences in the behaviour of the materials were only obtained at higher temperatures under load. But even in these temperature regions the static elongation due to load was obviously the dominating factor. Metallographical examination showed only slight changes in the structure such as are usually observed to accompany growth (complete decomposition of carbide, progressive oxidation, etc.). At the same time, the amount of graphitisation determined metallographically and chemically was in the same order and degree as the tendency to grow shown by these tests under load. The process is, therefore, to be so regarded that the change in volume due to decomposition of the carbide (primary growth) is magnified in a definite proportion under the influence of load, permitting a practical evaluation of the tests after only 20 hrs.

In order to confirm that the specific tendency of the carbide to decompose was a determining factor for the observed elongations, the irons D, E and F were fully graphitised by heating at 850 deg. C. to 900 deg. C., 24 hrs. being sufficient for F and about 80 to 100 hrs. being required for D and E. These were then heated in vacuum under a load of 1 kg. per sq. mm. at 650 deg. C. for 20 hrs., similar tests being made with the materials in their initial condition. The elongations of the graphitised test-pieces, ranging between 0.16 and 0.27 per cent., showed only insignificant differences, the maximum value being given by the mixer iron F. The materials as received gave average elongations from 0.21 per cent. for the electric iron D to 0.67 per cent. for the mixer iron.

Similar tests (heated for 20 hrs. at 650 deg. in vacuum and loaded with 1 kg. per sq. mm.) on two steels with carbon contents of 0.11 per cent. and 0.84 per cent. respectively gave elongations between 0.14 and 0.17 per cent., corresponding to those obtained with the ferritic cast irons.

The Scrap Dealer's Opportunity.

By "ONLOOKER."

It must be admitted that dealers in scrap metals have had a thin time during the past two years, for trade in non-ferrous metals has been slow, and as a result it has been impossible to negotiate business on the quick turnover basis essential to the profitable prosecution of this particular trade. The average scrap-metal dealer has not, as a rule, big capital resources, and putting metal "into pawn" with the banks robs a transaction of its profit very quickly; small profits and quick returns is the golden rule for the trader in scrap metals, and the evil of holding on to parcels too long has been shown during the falling markets of the past eighteen months, for many scrap merchants find themselves to-day with old stock which has been written down many times over.

On falling markets the losses sustained are not so heavy if parcels are rapidly passed into consumption, and when the upward reactions do come the concern that is in the running and closely in touch with consumers cannot fail to benefit. A broad view of the scrap situation to-day reveals the fact that there is too much "frozen stock" in existence. Do some of our advocates of the hold-fast policy realise what they are losing in interest and also in rent charges if the metal happens to be on rent at a station? There is yet another drawback to nursing parcels of scrap, and that is loss of weight, for whether it be through pilferage or from that peculiar type of rot common to all, but the very finest qualities of scrap, experience shows that old metals tend to waste away!

Not so many years ago, scrap metals were much more popular than they are to-day, for the margin between the selling price of secondary material and its value in virgin metals was a good deal wider, and a purchase therefore more attractive. Then came a period of increasing scarcity of scrap and an upward swing of the rate of production of copper and spelter, which speedily resulted in a discovery by manufacturers that new metals were a more favourable purchase. Hard on the heels of that phase was the development of "obstructionist" tactics by the Copper Exporters, who, by their system of limited quotas, etc., have driven manufacturers to the verge of despair and given outside producers every chance to push their wares. Of this the scrap merchants do not appear to have taken full advantage.

Reference has already been made to losses sustained by scrap merchants through falling values, and it is therefore not surprising to find that whenever markets have taken a turn for the better, old metals have been held off the market and prices pushed up rapidly. Such action is understandable, but it is a shortsighted policy and accounts for the paucity of scrap metal sales and the large stocks at present available. More than ever to-day, when virgin copper is being offered for the most part in American currency, the dealer in old copper has a chance to get his own back and ensure for his wares their former popularity among users. In learning to sell forward the scrap dealer has made some progress, for it is easier for consumers to cover "spread" sales than it used to be, but, generally speaking, the chances of securing anything like a decent tonnage of scrap at a reasonable price for a date, say, three months ahead, are pretty poor.

This thought leads on to consideration of consignment stock possibilities for scrap metal. In abolishing this facility in refined copper business, the Exporters met with much adverse criticism and undoubtedly lost trade. Why do not the scrap-metal merchants try something of the sort? Many of them have big stocks which are costing something in rent charges; these would lie at consumers' works free of such oncosts, and could be relied upon to advertise themselves every minute of the working day to a potential buyer! Admittedly, there are objections to, and difficulties in, such a course, but they are not insuperable.

Consumers the world over have lost heart and need reassurance. Sales methods which a few years ago were quite satisfactory no longer answer their purpose, and to succeed it is necessary to improve upon them. At the present time scrap-metal dealers have a great opportunity if only they will take it.

Catalogues Received.

Lighting.—The lighting of foundries has to be considered from the dual aspect of general and local, and there are several designs eminently suited for the latter application in an illustrated price list received from John Dugdell & Company, Limited, Hazel Grove, near Stockport.

Die Casting. — Fry's Metal Foundries, Limited, 23, Holland Street, Blackfriars, London, S.E.1, have sent us a 16-page brochure, which they have aptly designated "The A, B, C of Die Casting." The illustrations are excellent, as anybody who has tried to photograph this class of goods will well realise. Differentiation is made early in the book between pressure and gravity die castings. The materials, zinc base, yellow metals and aluminium alloys, are each dealt with in turn. A very intelligent section carries the caption "Die-Casting Design from 'User' Point of View." It could usefully be incorporated in any catalogue emanating from members of the foundry industry.

Finally, the three types of machines for making pressure die castings are discussed—the plunger, pneumatic and hydraulic. The last named is put forward as the best of all, and three outstanding advantages to be associated with its production are enumerated.

The Graphic Calculation of Transverse Strengths.

The transverse test is usually carried out on a round bar of standard diameter tested at a definite span. If fracture occurs in the centre of the bar, the transverse strength is easily computed from the breaking load, according to the formula $\sigma = \frac{P \cdot l}{4\ W}$, where P is the breaking load, l the span and W the moment of resistance of

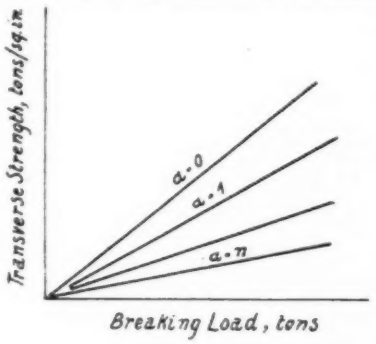


Fig. 1.

the bar. The calculation, however, becomes more troublesome if fracture does not occur in the centre, and the actual diameter of the bar slightly differs from the standard diameter. As R. Mitsche has shown, it is preferable in this case to use the graphic method, with the aid of

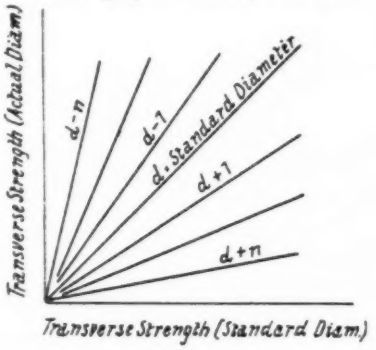


Fig. 2.

which the calculation done but once can fit all the cases.*

Two diagrams are prepared, one considering the position of the fracture, and the other the difference in diameter. If fracture occurs at a distance of a in. from the centre, the transverse strength is calculated from the breaking load according to the formula $\sigma = \frac{P \cdot l}{4\ W} - \frac{P \cdot a}{2\ W}$.

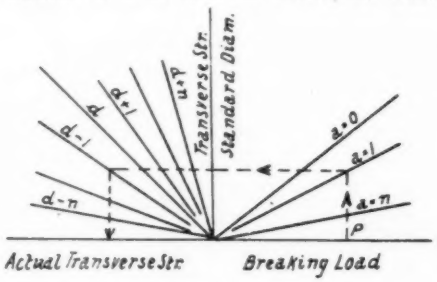


Fig. 3.

For a certain number of values of a (the range being dependent on practical requirements) and for a definite breaking load, the transverse strength is computed from this formula. The values found are plotted in the diagram shown in Fig. 1 and connected with the zero point. From the ordinate of this diagram the actual transverse strength can be read for any breaking load and any value of a in the range considered.

For a given breaking load the transverse strengths of two bars which differ in diameter from one another are reciprocally proportional to the third power of the diameters. If d is the diameter of the standard bar and σ its transverse strength, then the strength σ_1 of a bar of the diameter d_1 is $\sigma_1 = \frac{\sigma \cdot d^3}{d_1^3}$. For a definite breaking load and a number of values of d_1 $(= d \pm n)$ covering the range of differences from the standard diameter met with in practical service, the transverse strength is computed from this formula, and, with the values found, the diagram shown in Fig. 2 is prepared. As both the ordinate of Diagram 1 and the abscissa of Diagram 2 give the transverse strength for the standard diameter, the two diagrams can be combined in the manner illustrated in Fig. 3. Of course, the scale of the two coordinates must be the same. From Fig. 3 the actual transverse strength can be readily found for all the cases met with in practical testing. For saving space the two diagrams can also be drawn into one another as is shown in Fig. 4.

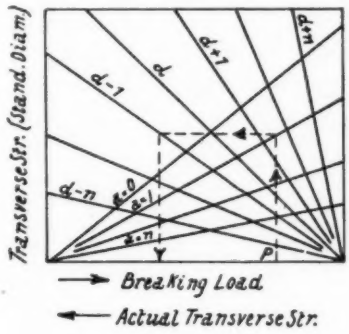


Fig. 4.

New I.B.F. Section Formed.

For some time considerable interest in the Institute of British Foundrymen has been shown by founders in the Preston and Leyland area, and mainly due to the activities of Mr. W. West, of the Farington Steel Foundry of Leyland Motors, Limited, the Lancashire Branch of the Institute held a propaganda meeting in the Technical Institute, Preston on November 4. The President of the Lancashire Branch, Mr. R. W. Stubbs, was in the chair, and Mr. F. W. Rowe, who is well known to members of the Institute gave a lecture on cast iron, in which he reviewed the present position and the probable future course of development of cast iron, its treatment and applications. Mr. T. Makemson, Secretary of the Institute, explained the Institute's objects, its methods of carrying out its work and the conditions of membership.

After a vote of thanks to Mr. Rowe, which was proposed by Mr. West, seconded by Mr. Dryden and carried unanimously, the meeting unanimously resolved to form itself into a section of the Lancashire Branch of the Institute. Some 30 firms and individuals promised to become members, and a provisional committee was elected to make immediate arrangements for meetings, etc, during the present session.

The secretary *pro tem.* is Mr. P. Leyland, of the Farington Steel Foundry of Leyland Motors, Limited, Leyland, and either he or the General Secretary will be glad to communicate with any prospective members in Preston and the surrounding district.

The Effect of Heat on the Permeability of Coal-Dust Facing Sands and Core-Sand Mixtures.

(*Concluded from page* 297.)

heating sea-coal facing sands, it is believed additional light is thrown on what happens when iron is poured into moulds faced with sea coal. First, the hot metal dries out a thin skin of moulding sand. The moisture, which is turned into steam, passes through the sand and out of the mould. After this moisture is expelled, the sand, becoming hotter, decreases markedly in permeability, due to the expansion of the grains of sand. At the same time, the volatile matter starts to distill from the sea coal, and the coal around the grains of sand swells.

The results of this Paper show that this swelling of the coal and expansion of the grains of sand decreases the permeability of the sea-coal sand mixtures to a very low figure. The volatile matter from the coal, therefore, can pass out only along the face of the mould. Meeting the molten metal filling the mould, the gas, or volatile matter, must act as a cushion or film between the sand and metal. That there is a decomposition of the carbon-rich gases of the volatile matter, to "smoke" the surface of the casting, or that a reducing action of these gases on the film of oxide covering the metal takes place, is not denied. The results obtained lead to the belief that a film of carbon-rich gas must be present between the molten iron and the face of the mould.

It is well known that the moisture content of moulding sand must be kept within limits. Excessive moisture, of course, causes blow holes in the casting. In like manner, the amount of sea coal used in a facing sand must be such that a slow evolution of gas from the coal takes place. Too rapid an evolution no doubt would cause a rough surface. While the permeability increased from a low figure on cooling from 1,000 deg. C. to room temperature, it was not thought necessary to plot the results. The curves on cooling were smooth and exactly like those previously reported.

Conclusions.

From the results of the tests, the following conclusions have been drawn:—(1) Additions of sea coal to natural moulding sands result in a decided diminution of permeability at room temperature. This effect is still exerted on heating the sand after the volatile matter has been removed; (2) the volatile matter in sea coal, together with the swelling of the coal, is responsible for the effectiveness of sea coal in producing a smooth surface on a casting; (3) mixtures of moulding sand and sea coal used as facing sands may vary considerably in proportions, without changing the behaviour of a given sand under heat; and (4) core sands with binders, like natural moulding sands, have progressively lower permeability when heated. The amount of binder used does not materially affect this property.

Cemented-tungsten-carbide steel can be ground either wet or dry with silicon-carbide wheels.

United States Steel Corporation.—The United States Steel directorate have declared the regular quarterly dividend of $1 per share on the common stock. The earnings for the third quarter, however, failed to cover the preferred dividend requirements of $1.75 per share. The net profit for the period was $3,187,131 (nominally £637,000), after deducting all charges and Federal taxes, but including a special income of $7,160,000 (nominally £1,430,000), compared with a net profit of $24,195,000 (nominally £4,839,000), including about $2,500,000 (nominally £500,000) special income for the corresponding quarter of 1930. It has been decided to withdraw $11,822,000 (nominally £2,360,000) from reserves for the purpose of meeting dividend requirements. The report for the third quarter shows that the profits decreased progressively each month.

* "Die Giesserei," 1931, vol. 18. pages 246-247.

This Week's News in Brief.

Trade Talk.

Messrs. Richard Dunston, Limited, shipbuilders, of Thorne, have secured an order for two steel lighters for Hull owners.

Albion Motors, Limited, Scotstoun, have received an order from the Government of India for 116 four-wheel 30-cwt. vehicles.

The Lowmoor Foundry, Limited, have removed their London sales office from 3, Victoria Street, to 15, St. James's Place, S.W.1.

It is stated that the Llanharry iron-ore mines in East Glamorgan are to be reopened. Mining operations have been suspended since July, 1930.

William M'Kinnon & Company, Limited, Spring Garden Iron Works, Aberdeen, have received an order for a complete rice-milling installation for Central America.

The Corsalli patented method of producing low-carbon cast iron has been taken over as from October 1 by Ferrocarnit G.m.b.H., of 9, Stresemann Strasse, Berlin, S.W.11.

An order has been placed with Messrs. Fodens, Limited; of Sandbach, Cheshire, for 68 Foden-Diesel wagons, required for the conveyance of road stone and other quarry traffic.

Employees of W. Simons & Company, Limited, shipbuilders and founders, Renfrew, have contributed £250 to infirmaries and charitable institutions in Glasgow and the West of Scotland.

Messrs. John M. Henderson & Company, Limited, Aberdeen, have received an order for three travelling cranes and auxiliaries from the North-Western Railway Company, Lahore, India.

The Central Electricity Board has placed a contract worth £337,000 for 230 miles of main transmission lines in South Scotland with British Insulated Cables, Limited, of Prescot, Lancashire.

The London & North Eastern Railway Company has placed a contract with the Furness Shipbuilding Company, Limited, of Haverton Hill-on-Tees, for 500 tons of steelwork for the renewal of bridges.

The registered offices of the Pearson & Knowles Coal & Iron Company, Limited, the Partington Steel & Iron Company, Limited, and the Moss Hall Coal Company, Limited, are now at 3, Finch Lane, London, E.C.3.

"Dalzo" weather-resisting steel, manufactured by Colvilles, Limited, will be largely used in the construction of a light-vessel which A. & J. Inglis, Limited, Pointhouse, Glasgow, are to build for the Commissioners of Northern Lighthouses.

Messrs. Frederick Braby & Company, Limited, Eclipse Ironworks, Glasgow, have booked export orders for black and galvanised sheets amounting in the aggregate to a substantial tonnage, and have been enabled to re-engage several hundreds of men.

Sheffield Chamber of Commerce has set up an Imports Committee in the expectation that a general tariff will be introduced in the near future. The Chamber states that the committee will consider details of such a tariff and its incidence upon Sheffield trade.

Messrs. R. & W. Hawthorn, Leslie & Company, Limited, Hebburn-on-Tyne, have booked an order for a cargo vessel of 9,000 tons deadweight for Messrs. J. & C. Harrison, of London. The owners placed an order with the firm some weeks ago for a similar vessel.

An agreement has been made between the Armstrong Whitworth group of companies and the Société Anonyme Adolph Saurer, of Arbon, Switzerland, as a result of which commercial vehicles using heavy oil will be manufactured at the Armstrong Whitworth works at Scotswood, Newcastle.

The Burntisland Shipping Company, Limited, Burntisland, are to build a 1,400-ton cargo steamer for North-East Coast owners. This means the re-opening of the yard, which has been closed for several months. They have also obtained an order from London owners to build a 7,000-ton cargo vessel of the Economy type.

A Wearside Industries Exhibition was opened at Sunderland recently. Mr. Samuel Storey, M.P., said that they wanted to rebuild the industries of Sunderland and to get a better balance without having to depend on one main industry, shipbuilding. The exhibition includes over 40 stands illustrating some of Sunderland's lesser industries.

Speaking at the annual meeting of the American Iron and Steel Institute, Mr. Charles M. Schwab, chairman of the Bethlehem Steel Corporation, said that a sound basis for a revival was now being laid. He praised the spirit in which labour had accepted the wage reductions to meet existing conditions, and added that, in his opinion, security prices were unduly depressed.

Orders for two more cargo steamers have been placed with Lithgows, Limited, Port Glasgow, by J. & C. Harrison, Limited, London. Each vessel will have a deadweight tonnage of 9,000 and propelling machinery consisting of triple-expansion engines. Messrs. Lithgows now have on order over 45,000 tons deadweight shipping for Messrs. Harrison, and have more work on hand than any Clyde concern.

The City of Birmingham Information Bureau states that it is in communication with 14 Continental and American firms, who are contemplating opening works in the city. Among the countries represented, definite applications for premises and sites have been received from France, Germany and Holland, while there have been tentative inquiries from the United States, Sweden and Belgium. Four foreign firms have actually acquired factories in Birmingham during the past few weeks. In addition to the inquiries from foreign firms, the Bureau within the past few weeks has received inquiries from 15 English firms for factories and sites in Birmingham, a number of which are from local manufacturers who are anxious to secure larger premises.

The Great Western Railway states that, as a result of extensive inquiries made of manufacturers throughout its system, it is anticipating an improvement in its goods and passenger traffic. These inquiries reveal definite progress in trade and industry, as will be seen from the following:—In the Birmingham enamelled hollow-ware industry business lost for years is being recaptured. In one case 88 container loads were despatched during the first two weeks of October, as compared with a previous monthly average of 78. Warrington iron and steel manufacturers report:—(1) Working full pressure in several branches at half strength a month ago; (2) nail works increasing output, 100 additional hands employed; (3) working at full pressure to cope with orders; (4) reopened iron bar depôt to full capacity; (5) business brisker now than for many years. At Wellington works which have been standing idle for an extensive period restarted; orders on hand for many weeks ahead. At Hawarden Bridge orders secured for 2,000 tons of steel sheets for export and works reopening. At Port Talbot, Briton Ferry, Llanelly, Bynea and Panteg more blast furnaces in commission. At Rogerstone four new rolls installed and 50 additional men employed. At Newport 36 of 44 mills working, of which 27 are working overtime to cope with orders in hand. Another company working to capacity with several extensive orders to execute. At Neath and Llanelly galvanising works are now fully engaged, and there is business from India and the Near East. Although the tinplate output is below normal, shipment through South Wales docks in the week ended October 17 was the largest since January.

Obituary.

Mr. N. W. Kidner, a director of the Islip Iron Company, Limited, died last week at Kettering Hospital as the result of a motor accident.

Mr. E. F. Blakeley, late managing director of Messrs. E. F. Blakeley & Company, Limited, constructional engineers, Birkenhead, died recently, aged 76. From 1924 to 1928 he was a member of the Wallasey Town Council.

Mr. Frank Ellison died at his home in Sheffield on Saturday, October 31. Mr. Ellison, who was 67, was associated with Messrs. Hadfields, Limited, for more than 40 years. For many years he was manager of the machine shops, and during the war he was manager of the shell department. He retired four years ago.

Wire ropes should be lubricated sparingly with a heavy lubricant to prevent entry of moisture.

Personal.

Mr. George Whittingham, an employee of the Motherwell Bridge Works, has just been awarded the certificate of merit of the Technological Institute of Great Britain.

Sir William Ellis has decided to retire from his appointments with Messrs. John Brown & Company, Limited, and associated companies, on December 31. He has occupied various positions from under-manager to managing director for 44 years.

Mr. J. H. Humphryes (Messrs. Braithwaite & Company, Engineers, Limited) was elected President of the British Steelwork Association for the year 1931-32 at the annual general meeting of the Association on Wednesday. Mr. Ben Walmsley (Messrs. Dorman, Long & Company, Limited) was elected Vice-President.

Bailie Archibald Logan has been elected Provost of Falkirk for the next three years. Bailie Logan, who has had a long period of service in the Falkirk Town Council, is intimately connected with the light-castings industry, being well known as the organiser of the Central Moulders' Ironfounding Union. Captain H. J. Kennard, managing director of the Falkirk Iron Company, Limited, has been elected senor Bailie of the Falkirk Town Council.

Mr. C. le Maistre, director of the British Engineering Standards Association, left London last Saturday on a tour of Australia, New Zealand, Canada and the United States, which he is undertaking at the request of the Board of Trade, supplemented by a direct invitation from the New Zealand Government. It was decided at the Imperial Conference that the standardisation work in the Dominions and in this country should be co-ordinated.

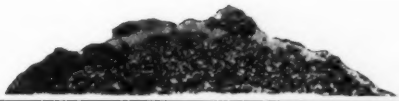
Falkirk Foundry Trade Prospects.

At long last there would appear to be welcome signs of genuine trade revival in the Falkirk district. There is definitely abroad a sensation of change which, without undue optimism, may be construed as a change for the better. There are already signs of brisker movement in local industrial circles, which may be attributed in general to the new horizon of stability presented in consequence of the national political transformation. Responsible officials of the principal foundries in Falkirk and district consider that a revival of trade is imminent and that local firms stand a good chance of participating in whatever prosperity may arrive. The Carron Company reports a distinct forward trend in the past week or two; buyers are tending to look further ahead than has hitherto been their policy, and more business has been booked in recent weeks than for a long time past. The demand is specially marked in foundry products to be utilised in new housing schemes, and in every line a brighter note is apparent. The Falkirk Iron Company also reports a steady return of trade, and the Grangemouth Iron Company has at present sufficient volume of work on hand to maintain normal employment until at least the end of the current year. The other foundries exhibit a similarly optimistic feeling. The firebrick industry, which has been one of the hardest hit of local industries, is giving indications of a return to better times, and the J. G. Stein concern is at present making extensions at its Manuel works and has engaged extra workmen.

"Style's" Moulding System.

Information is required as to the nature of Style's patent moulding system, said to be practised in the Derby area.

Messrs. W. T. Henley's Telegraph Works Company, Limited, have received a contract from the Central Electricity Board, through Messrs. Merz & McLellan, consulting engineers, for the supply and erection of 43 miles run of 0.1 sq. in. steel-cored aluminium conductors on lattice-steel towers, for a working pressure of 33,000 volts. This is an extension to the contract for the South-East England scheme which was placed with Messrs. Henley's last year and on which work is at present proceeding.

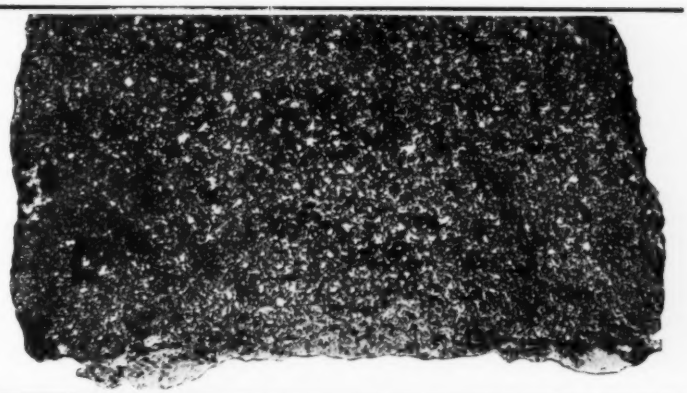


PIG IRON

MANUFACTURERS of Foundry, Basic and Hematite qualities.

Delivery from stock.

Booklet giving analyses, etc., will be sent on request.



DORMAN LONG

& COMPANY LIMITED, INCORPORATING
BOLCKOW VAUGHAN & CO. LTD., MIDDLESBROUGH

THE SIROCCO FAN

PIONEER OF MODERN MULTIBLADED FANS

Available in a large variety of sizes and types . . . .
For every purpose involving the movement of air or gases.

DAVIDSON & CO., LIMITED.
SIROCCO ENGINEERING WORKS, BELFAST.
LONDON, CARDIFF, BRISTOL, GLASGOW, DUBLIN,
MANCHESTER, BIRMINGHAM, NEWCASTLE, COLOMBO.

TRADE SIROCCO MARK

Raw Material Markets.

Business in the iron and steel trades continues to expand steadily. The majority of the big consuming works have contracted for their requirements into 1932, but a fair amount of business is being done with the foundries, whose position appears to be improving slightly, and who are calling for heavier deliveries on current contracts. The producers have not raised their prices, and hope shortly to put more furnaces into action.

Pig-Iron.

MIDDLESBROUGH.—There has been no alteration in prices, but business continues to expand steadily. Home consumption appears to be improving, and an increase in production will be necessary if the demand continues on the present basis. It is thought that the makers would rather bring more furnaces into operation than raise the level of prices. Prices remain as follow:—No. 1 Cleveland foundry iron, 61s.; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

Business in the East Coast hematite market continues on a steady basis. The export market is quiet, but home consumers have recently been buying considerable supplies. Prices remain unchanged. There is also a steady demand for hematite on the West Coast, and demand exceeds current production, although many consumers are covered for the next few months. There continues to be a strong demand from abroad. It is reported that there are no unsold stocks in West Cumberland. Special qualities of Bessemer mixed numbers are in request at from 68s. 6d. to 71s., at works.

LANCASHIRE.—It was reported last week that orders at current prices were placed for deliveries of pig-iron into the first three months of 1932. Present prices are being maintained. Foundries have recently been buying heavily, but the iron is mostly for replenishing stocks, which had fallen to a low level. For delivery to users in the Manchester price zone, Staffordshire, Derbyshire and North-East Coast brands of No. 3 iron are quoted at 67s. per ton, with Northamptonshire foundry iron at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at 86s. 6d. to 87s. and West Coast hematite iron at about 81s. per ton.

MIDLANDS.—The demand remains steady, but sales are on a smaller scale, as the majority of the big consumers are already covered. No change in prices was made at the recent meeting of the Central Pig-Iron Producers' Association. For delivery to Birmingham and Black Country stations, producers continue to quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—There has been some forward buying to the end of the year, but prices remain unaltered. The position of the foundries is improving somewhat, and producers are being asked for heavier deliveries. There has been a noticeable increase in the import of pig-iron from Holland. The official price of Scottish No. 3 foundry iron remains at 69s. 6d. Cleveland No. 3 remains at 62s. 6d. per ton f.o.t. Grangemouth.

Coke.

Business has fallen off slightly in the Cleveland coke market, and the price of good Durham furnace coke varies between 17s. 6d. and 18s. Blast-furnace coke is also stronger in the Yorkshire market. There is a quieter market for coke in the Staffordshire area, due to the number of advance bookings. Best Durham coke is quoted at from 37s. 6d. to 39s. per ton delivered in South Staffordshire, with lower grade fuel at about 35s. Welsh foundry coke prices vary from 35s. to 47s. 6d. delivered.

Steel.

The finished-steel works have yet to feel any improvement in trade, although the better position of the shipbuilding industry should soon be reflected in an increased demand for ship-plates and heavy sections. The British semis mills are in a better position. Less work is going abroad, and Continental makers are only accepting orders for immediate delivery.

Scrap.

There has been no expansion in the demand for scrap in the Cleveland district, heavy steel scrap being offered at 40s. per ton, while light-castings scrap is maintained at 33s. 6d. On the Midlands market, the demand is much more vigorous, and many suppliers will only sell for immediate delivery. Good heavy unsheared wrought iron is easily sold at 50s. per ton. Light cast-iron scrap is strong at 40s. per ton delivered. The South Wales scrap market remains in a poor position, there being little demand. There has been a larger turnover in the Scottish market during the last week, but the majority of spot prices are unaltered, though firmly held. Premiums are being asked for forward delivery.

Metals.

Copper.—The fluctuations of the dollar exchange during the last week appear to have had little effect upon the price of standard copper, but there has been a certain amount of speculative buying, which has had some influence. The demand remains steady, the majority of the business being done by outside interests, which are quoting at levels below the 7.50 cents c.i.f. Europe asked by the Copper Exporters.

Closing quotations :—

Cash.—Thursday, £36 15s. to £36 16s. 3d.; Friday, £37 7s. 6d. to £37 10s.; Monday, £38 10s. to £38 12s. 6d.; Tuesday, £39 2s. 6d. to £39 3s. 9d.; Wednesday, £36 17s. 6d. to £37.

Three Months. — Thursday, £37 7s. 6d. to £37 8s. 9d.; Friday, £37 18s. 9d. to £38; Monday, £39 2s. 6d. to £39 5s.; Tuesday, £39 15s. to £39 16s. 3d.; Wednesday, £37 7s. 6d. to £37 10s.

Tin.—There is little to report in the London market. Only a moderate business has passed. Eastern sales have been on a smaller scale. American buying is still very dull, while European is none too good. Hopes are expressed that the statistical position at November 30 will show an improvement.

Official closing prices :—

Cash.—Thursday, £128 12s. 6d. to £128 15s.; Friday, £130 to £130 5s.; Monday, £132 15s. to £132 17s. 6d.; Tuesday, £134 10s. to £134 12s. 6d.; Wednesday, £132 to £132 5s.

Three Months. — Thursday, £130 15s. to £130 17s. 6d.; Friday, £132 2s. 6d. to £132 5s.; Monday, £134 15s. to £134 17s. 6d.; Tuesday, £136 10s. to £136 12s. 6d.; Wednesday, £134 to £134 2s. 6d.

Spelter.—There has been an improvement in the position of spelter, due partly to the depreciation of sterling and partly to the better situation of the consuming works, whose demand for zinc should soon show further improvement.

Daily fluctuations :—

Ordinary.—Thursday, £13 7s. 6d.; Friday, £13 15s.; Monday, £14 2s. 6d.; Tuesday, £14 3s. 9d.; Wednesday, £13 16s. 3d.

Lead.—There has been an increase in buying, although only some of the supplies sold are going to consumers. The position of this metal, however, seems to show a definite improvement, and supplies reaching this country are going more rapidly into consumption.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £13 17s. 6d.; Friday, £14 10s.; Monday, £15; Tuesday, £15 1s. 3d.; Wednesday, £14 17s. 6d.

Grey Iron Institute.—At the fourth annual meeting of the American Grey Iron Institute, held at West Baden Springs last month, Mr. A. E. Hageboeck, of the Frank Foundries Corporation, Moline, Ill., was elected President for the ensuing year. Mr. J. L. Carter, of Sacks-Barlow Foundries, Inc., Newark, N.J., was elected first Vice-President, succeeding Mr. Hageboeck, and Mr. J. H. Bruce, of the Bowler Foundry Company, Cleveland, was elected second Vice-President. Subjects which were discussed at the meeting included a standard cost system evolved by the Institute, standard test-bars and a standard cupola charging sheet submitted by Mr. Oliver Smalley, who was appointed director of research a year ago.

Contracts Open.

Belfast, November 25.—Iron and steel stores, for the Belfast Harbour Commissioners. The Harbour Office, Belfast.

Caerau, November 14.—Works for the Mid-Glamorgan Water Board:—Contract No. 28—providing and laying about 3,000 yds. of 8 in. to 4 in. diameter cast-iron water mains, with all fittings; Contract No. 29—providing and laying about 220 yds. of 4 in. diameter cast-iron pipes, with all fittings, and the provision and erection of a cast-iron tank of 20,000 galls. capacity. Messrs. Thomas & Morgan & Partners, engineers, Pontypridd. (Fee £5 for each contract, returnable.)

Dublin, November 18.—Iron and steel stores, for the Dublin Port and Docks Board. Mr. E. H. Bailey, secretary, Westmoreland Street, Dublin.

Dublin, November 25.—Iron and steel stores, for the Great Southern Railways Company. The Stores Superintendent, General Stores Department, G.S. Railways, Inchicore, Dublin.

Hitchin, November 17.—Supply and laying of approximately 3,800 lineal yds. of 4-in., 3-in. and 2-in. cast-iron pipes, etc., for the Hitchin Rural District Council. Mr. B. S. Ewing, Bank Chambers, Brand Street, Hitchin. (Fee £2 2s., returnable.)

Shaftesbury, November 14.—4,200 yds. of 3-in. spun or cast-iron pipe (contract No. 1), for the Shaftesbury Rural District Council. Mr. A. J. Martin, 108, St. George's Square, Westminster, S.W.1. (Fee £2 2s., returnable.)

Worthing, November 16.—Iron castings, for the Town Council. Mr. P. E. Harvey, Beach House, Worthing.

The Lighting of Foundries.

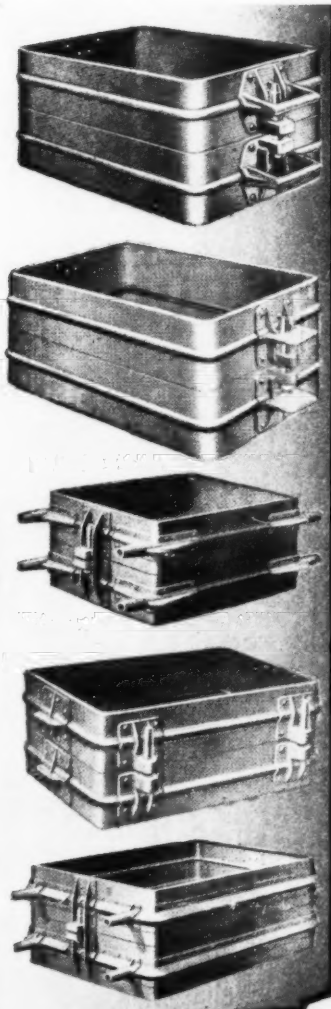
(*Concluded from page* 298.)

protect them from possible injury. There are many systems in use, and in order to select the best each case must be considered on its own merits. When dealing with establishments such as foundries, one of the steel conduit systems will be found quite suitable, the heavy gauge, screwed, solid-drawn system being the highest grade obtainable. With such a system there is little danger of trouble from water, dampness or mechanical injury. All conduits and their various fittings should be either black enamelled or galvanised, both inside and out, to ensure protection against corrosion. Galvanising is, of course, more expensive, but this form of protection is essentially more proof against corrosion than enamelling. All conduit and other metal work connected to it should be earthed.

As an alternative to the use of steel conduit one of the several metal-cased wiring systems may be used for surface wiring, in which the V.I.R. conductors are sheathed with a special lead alloy—for this reason they are frequently referred to as "lead-covered wiring." The C.T.S. system mentioned above differs from all other systems of wiring in the fact that no metallic armouring is provided for the conductors, nor are they intended to be enclosed in steel conduit or other form of mechanical protection. Where portable electric lights are used, such as for inspection of storage tanks, etc., it is necessary to have a system of wiring which is extremely robust, reliable, and which can be moved about from day to day by unskilled labour. For this work C.T.S. cable will be found quite suitable, while for outside portable lighting fittings, such as in loading bays, etc., flexible steel metallic tubing may be used.

Lifting chains in continuous use should be tested yearly.

Contracts have been awarded by the London & North Eastern Railway Company to Messrs. Smith, Patterson & Company, Limited, Blaydon-on-Tyne, for 1,000 tons of cast-iron chairs, and to the Anderston Foundry Company, Limited, for 500 tons of chairs.



STERLING FOUNDRY SPECIALTIES LTD. BEDFORD.

LONDON OFFICE —
13, VICTORIA STREET, S.W.1.

TELEPHONE :—
3345 BEDFORD.

TELEGRAMS :—
"STERFLASK, BEDFORD."

.....they play an important part in modern foundry production —— save unnecessary labour, produce accurate castings & reduce your Box Maintenance costs —

Sterling

SOLID RIBBED ROLLED STEEL

FOUNDRY MOULDING BOXES

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	36	17	6
Three months	37	7	6
Electrolytic	41	10	0
Tough	37	15	0
Best selected	38	0	0
Sheets	70	0	0
India	49	0	0
Wire bars	44	5	0
Do., December	44	5	0
Do., January	44	5	0
Ingot bars	44	5	0
H.C. wire rods	46	10	0
Off. av. cash, Oct.	35	0	1 1/11
Do., 3 mths., Oct.	35	16	10 27/44
Do., Sttlmnt., Oct.	34	19	10 7/11
Do., Electro, Oct.	41	8	10 3/11
Do., B.S., Oct.	37	19	2
Do., wire bars, Oct.	41	17	8 8/11
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			7½d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5½d.
Sheets to 10 w.g.	8d.
Wire	8½d.
Rolled metal	7½d.
Yellow metal rods	5½d.
Do. 4 × 4 Squares	6d.
Do. 4 × 3 Sheets	6d.

TIN.

	£	s.	d.
Standard cash	132	0	0
Three months	134	0	0
English	133	10	0
Bars	136	0	0
Straits	135	15	0
Australian	134	0	0
Eastern	136	15	0
Banca (nom.)	147	10	0
Off. av. cash, Oct.	127	0	9 6/11
Do., 3 mths., Oct.	129	16	7 7/11
Do., Sttlmt., Oct.	127	0	2 8/11

SPELTER.

	£	s.	d.
Ordinary	13	16	3
Remelted	12	15	0
Hard	10	12	6
Electro 99.9	16	10	0
English	14	17	6
India	12	15	0
Zinc dust	23	0	0
Zinc ashes	3	15	0
Off. aver., Oct.	12	19	5 33/44
Aver. spot, Oct.	12	14	7 10/11

LEAD.

	£	s.	d.
Soft foreign ppt.	14	17	6
English	16	10	0
Off. average, Oct.	13	4	11 23/44
Average spot, Oct.	13	4	6 6/11

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	0	0
Do., V.M. ex-whf.	24	10	0
Rods	30	0	0
Boiler plates			—
Battery plates			—

ANTIMONY.

	£	s.	d.
Special brand, Eng.	40	0	0
Chinese	28	0	0
Crude	22	0	0

QUICKSILVER.

Quicksilver £17

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	8	0	0
45/50%	10	2	6
75%	16	12	6
Ferro-vanadium—			
35/50%	12/8 lb. Va. plus 20%		
Ferro-molybdenum—			
70/75% c. free	4/2 lb. Mo. plus 30%		
Ferro-titanium—			
23/25% carbon-free	11½d. lb.		
Ferro-phosphorus, 20/25%	£16	0	0
Ferro-tungsten—			
80/85%	1/8½ lb. plus 20%		
Tungsten metal powder—			
98/99%	1/11½ lb. plus 20%		
Ferro-chrome—			
2/4% car.	£34	0	0
4/6% car.	£24	15	0
6/8% car.	£23	10	0
8/10% car.	£22	10	0
Ferro-chrome—			
Max. 2% car.	£35	17	6
Max. 1% car.	£40	0	0
Max. 0·70% car.	£51	0	0
70% carbon-free	11d. lb.		
Nickel—99%	£220 to £225		
Ferro-cobalt	8/6 lb.		
Aluminium 98/99%	£95	0	0
Metallic chromium—			
96/98%	3/1 lb.		
Ferro-manganese (net)—			
76/80% loose	£10 15 0 to £11 5 0		
76/80% packed	£11 15 0 to £12 5 0		
76/80% export	(nom.) £ 9 0 0		
Metallic manganese—			
94/96% carbon-free	1/6 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten 2s. 0d.
Finished bars, 18% tungsten 2s. 9d.
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares, 3 in. and over 4d. lb.
Rounds and squares, under ½ in. to ¼ in. 3d. lb.
Do., under ¼ in. to 1/16 in. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in. 3d. lb.
Do., under ¼ in. × ¼ in. 1/- lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length, 10% extra.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel	2	5	0 to	2	7	6
Bundled steel and shrngs.	1	17	6 to	2	5	0
Mixed iron and steel	1	17	6 to	2	0	0
Heavy cast iron	2	6	0 to	2	7	6
Good machinery for foundries				2	10	0

Cleveland—	£	s.	d.	£	s.	d.
Heavy steel				2	0	0
Steel turnings				1	7	0
Cast-iron borings				1	2	0
Heavy forge				2	7	6
W.I. piling scrap				2	0	0
Cast-iron scrap	2	3	6 to	2	6	6

Midlands—	£	s.	d.	£	s.	d.
Light cast-iron scrap				2	0	0
Heavy wrought				2	10	0
Steel turnings, f.o.r.				0	19	6

Scotland—	£	s.	d.	£	s.	d.
Heavy steel				2	0	0
Ordinary cast iron				2	7	6
Engineers' turnings				1	10	0
Cast-iron borings				1	10	0
Wrought-iron piling				2	5	0
Heavy machinery				2	12	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	30	0	0
Brass	21	0	0
Lead (less usual draft)	11	10	0
Tea lead	8	10	0
Zinc	6	0	0
New aluminium cuttings	62	0	0
Braziery copper	28	0	0
Gunmetal	25	0	0
Hollow pewter	82	0	0
Shaped black pewter	60	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	65/6
Hematite M/Nos.	65/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
,, No. 4 forge*	61/-
,, No. 3 fdry.*	66/-
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	57/6
,, fdry. No. 3*	62/6
,, fdry. No. 1*	65/6
Derbyshire forge*	61/-
,, fdry. No. 3*	66/-
,, fdry. No. 1*	69/-
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
,, No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
,, fdry. No. 3	63/6
Lincs forge	—
,, fdry. No. 3	63/6
E.C. hematite	79/-
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
,, fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	86/6 to 87/-
Clyde, No. 3	86/6 to 87/-
Monkland, No. 3	86/6 to 87/-
Summerlee, No. 3	86/6 to 87/-
Eglinton, No. 3	86/6 to 87/-
Gartsherrie, No. 3	86/6 to 87/-
Shotts, No. 3	86/6 to 87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	15	0 to	10	5	0
Nut and bolt iron	8	5	0 to	8	10	0
Hoops					—	
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip					—	
Bolts and nuts, ¾ in. × 4 in.					—	

Steel—	£	s.	d.	£	s.	d.
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	15	0 to	9	15	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¼ in. (Untested)	6	17	6 & up.			
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)				9	10	0
Black sheets, 24g.	8	5	0 to	9	5	0
Galv. cor. shts.	9	7	6 to	9	15	0
Galv. flat sheets	9	17	6 to	10	5	0
Galv. fencing wire, 8g. plain					—	
Billets, soft	5	7	6 to	5	12	6
Billets, hard				6	12	6
Sheet bars	5	0	0 to	5	10	0
Tin bars				5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12½d.
Rods	11½d.
Tubes	16¾d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
3/- to 10 g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.76
No. 2 foundry, Valley	16.00
No. 2 foundry, Birm.	12.00
Basic	16.76
Bessemer	18.26
Malleable	18.26
Grey forge	17.76
Ferro-mang. 80%	85.00
O.-h. rails, h'y, at mill	43.00
Billets	29.00
Sheet bars	29.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.80
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	2.90
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 25/-
,, furnace	14/- to 16/-
Durham and Northumberland—	
,, foundry	15/- to 15/6
,, furnace	15/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	14/-
,,	28×20 ,,	28/-
,,	20×10 ,,	20/3
,,	18¾×14 ,,	14/9
C.W.	20×14 ,,	13/-
,,	28×20 ,,	25/9
,,	20×10 ,,	19/6
,,	18¾×14 ,,	14/3

SWEDISH CHARCOAL IRON & STEEL.

	£	s.	d.	£	s.	d.
Pig-iron	£6	0	0 to	£7	0	0
Bars, hammered, basis	£16	10	0 to	£17	0	0
Bars and nail-rods, rolled, basis	£15	17	6 to	£16	5	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£32	0	0 to	£33	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water ..	58½%	52½%
Steam ..	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Nov.	5 ..	36	15	0	inc.	21/3
,,	6 ..	37	7	6	,,	12/6
,,	9 ..	38	10	0	,,	22/6
,,	10 ..	39	2	6	,,	12/6
,,	11 ..	36	17	6	dec.	45/-

Electrolytic Copper.

		£	s.	d.		
Nov.	5 ..	42	10	0	inc.	30/-
,,	6 ..	42	10	0	No change	
,,	9 ..	43	10	0	inc.	20/-
,,	10 ..	43	10	0	No change	
,,	11 ..	41	10	0	dec.	40/-

Standard Tin (cash).

		£	s.	d.		
Nov.	5 ..	128	12	6	inc.	10/-
,,	6 ..	130	0	0	,,	27/6
,,	9 ..	132	15	0	,,	55/-
,,	10 ..	134	10	0	,,	35/-
,,	11 ..	132	0	0	dec.	50/-

Tin (English ingots).

		£	s.	d.		
Nov.	5 ..	130	5	0	inc.	10/-
,,	6 ..	131	10	0	,,	25/-
,,	9 ..	134	5	0	,,	55/-
,,	10 ..	136	0	0	,,	35/-
,,	11 ..	133	10	0	dec.	50/-

Zinc Sheets (English).

		£	s.	d.		
Nov.	5 ..	24	0	0	No change	
,,	6 ..	24	0	0	,,	,,
,,	9 ..	24	0	0	,,	,,
,,	10 ..	24	0	0	,,	,,
,,	11 ..	24	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Nov.	5 ..	13	7	6	inc.	3/9
,,	6 ..	13	15	0	,,	7/6
,,	9 ..	14	2	6	,,	7/6
,,	10 ..	14	3	9	,,	1/3
,,	11 ..	13	16	3	dec.	7/6

Lead (English).

		£	s.	d.		
Nov.	5 ..	15	5	0	inc.	5/-
,,	6 ..	16	0	0	,,	15/-
,,	9 ..	16	10	0	,,	10/-
,,	10 ..	16	10	0	No change	
,,	11 ..	16	10	0	,,	,,

AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895	2 3 0	2 3 0	2 2 6	2 2 6	2 2 6	2 4 0	2 3 6	2 4 0	2 5 0	2 5 6	2 6 6	2 5 6	2 3 11½
1896	2 5 6	2 6 0	2 6 0	2 6 0	2 6 0	2 5 6	2 5 0	2 5 0	2 5 0	2 6 0	2 7 0	2 8 6	2 5 11½
1897	2 10 0	2 11 0	2 9 0	2 8 6	2 8 0	2 7 0	2 7 0	2 7 0	2 6 0	2 6 0	2 6 6	2 7 6	2 7 9½
1898	2 7 6	2 8 0	2 8 0	2 8 0	2 8 6	2 10 0	2 10 0	2 10 0	2 10 0	2 11 0	2 14 0	2 14 0	2 9 11
1899	2 13 0	2 14 0	2 14 0	2 14 0	3 0 0	3 2 0	3 13 0	3 16 6	3 15 0	3 16 6	3 16 6	4 0 0	3 6 2½
1900	4 0 0	4 0 0	4 0 0	4 1 6	4 1 0	3 18 0	3 13 6	3 12 6	3 11 0	3 11 0	3 9 6	3 8 0	3 15 5
1901	2 13 6	2 17 0	2 15 0	2 15 0	2 14 0	2 13 9	2 13 6	2 13 6	2 14 6	2 13 0	2 12 6	2 16 6	2 14 3½
1902	2 17 6	2 17 6	2 15 6	2 16 9	2 16 6	2 16 6	2 16 6	2 17 0	2 18 6	2 18 6	2 17 6	2 17 6	2 17 1½
1903	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1904	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1905	2 13 0	2 13 0	2 11 6	2 12 6	2 12 0	2 12 0	2 12 3	2 12 3	2 14 0	2 16 6	3 0 0	3 0 6	2 14 1
1906	3 2 0	3 5 0	3 3 0	3 0 6	2 17 0	2 18 6	2 18 0	2 16 6	2 19 0	3 0 6	3 1 6	3 7 0	3 0 8½
1907	3 7 0	3 7 0	3 5 0	3 2 0	3 4 0	3 8 0	3 6 0	3 5 0	3 4 0	3 2 6	3 1 0	2 18 6	3 4 2
1908	2 15 0	2 14 6	2 14 6	2 15 6	2 14 0	2 13 0	2 13 0	2 11 6	2 12 6	2 13 0	2 12	2 12 6	2 13 5½
1909	2 13 0	2 12 6	2 11 6	2 12 0	2 12 6	2 12 6	2 12 0	2 12 6	2 14 6	2 15 0	2 14 6	2 14 0	2 13 0½
1910	2 13 9	2 14 0	2 14 0	2 14 4	2 15 0	2 15 0	2 14 9	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0	2 14 7½
1911	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 14 6	2 15 0	2 15 0	2 15 8½
1912	2 17 4½	2 17 6	2 17 6	3 1 1½	3 2 6	3 3 9	3 6 3	3 7 6	3 10 10½	3 12 6	3 13 3½	3 14 6	3 5 4
1913	3 15 7	3 15 0	3 11 10½	3 11 4½	3 10 2½	3 6 10½	3 4 2½	3 2 9	3 1 9	3 1 0	2 19 3	2 17 2½	3 6 5
1914	2 17 2½	2 18 0	2 18 0	2 17 0	2 17 0	2 16 7½	2 16 0	3 2 10	3 1 0	2 19 9½	2 16 11½	2 18 1½	2 18 2
1915	3 1 2	3 3 11	3 5 9	3 18 8½	3 13 7	3 14 1	3 15 0	3 13 3	3 12 0½	3 11 1	3 14 0	4 3 3	3 12 2½
1916	4 4 6½	4 11 6	4 11 6½	4 7 6	4 7 6	4 7 6	4 10 0	4 12 10	4 12 6	4 12 6	4 12 6	4 12 6	4 8 6½
1917	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1918	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1919	4 12 6	4 12 6	4 12 6	4 12 6	7 2 6	7 5 0	8 8 5	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	7 3 10
1920	9 13 9	10 0 0	10 5 3	10 15 3	11 10 0	12 2 6	12 5 0	13 1 3	14 7 6	14 5 0	14 5 0	14 5 0	12 12 1½
1921	12 11 8	10 8 9	9 2 6	8 2 0	8 0 0	8 0 0	8 0 0	8 1 8	7 4 0	6 7 6	5 7 6	4 16 10	8 0 2
1922	5 5 0	4 17 6	4 15 0	4 15 0	4 12 6	4 12 6	4 12 6	4 12 6	4 11 3	4 10 0	4 10 0	4 10 0	4 13 7½
1923	4 12 8½	5 0 2	6 2 6	6 8 7½	6 2 5	5 11 9	5 9 1½	5 4 0	5 0 0	5 0 9	5 0 7	5 2 9	5 7 11½
1924	5 3 0	5 3 0	5 3 0	5 3 0	5 2 10	5 1 3	4 17 11	4 15 6	4 13 6	4 10 1½	4 10 0	4 10 3	4 17 9½
1925	4 10 0	4 9 0	4 6 9	4 5 2½	4 3 0	4 0 1½	4 17 1½	3 15 7½	3 14 3½	3 13 4½	3 13 4½	3 13 2½	4 1 9
1926	3 14 9	3 15 3	3 15 6	3 15 3½	3 17 6	4 5 9	4 16 9	*	*	*	*	4 12 6	4 0 1½
1927	4 13 9½	4 13 3	4 11 1½	4 9 4½	4 6 1½	3 19 1½	3 16 1½	3 15 6	3 13 4½	3 13 4½	3 14 0	3 13 6½	4 1 6½
1928	3 13 2½	3 12 3½	3 12 3	3 12 3	3 11 6	3 10 0	3 8 3	3 7 8½	3 7 6	3 7 9½	3 8 3	3 7 6	3 9 10½
1929	3 8 3½	3 10 4½	3 10 10½	3 11 0	3 11 2½	3 12 0	3 12 4½	3 14 6	3 15 1½	3 17 0	3 17 0	3 17 6	3 13 1½
1930	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 15 0	3 12 0	3 12 0	3 12 0	3 10 1½	3 9 6	3 14 4½
1931	3 9 6	3 9 6	3 9 6	3 9 6	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	—	—	—

* No prices available during strike period.

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"Jackman" sand whizzer	...	£12
No. 0 "Jackman" Cupola	...	£32
Two "NORTON" D.E. fettling grinders	... ... each	£14

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